MAY 1960

TOOLING & PRODUCTION

Magazine

60" OD-ID Cylindrical and Face Grinder Tackles Large Bearing Rings . . . . . page 48

Installing Q-C, page 43 . . . Bonuses for Q-C, page 49
Selecting and Treating Tool Steels, page 54
Don't Wait to Fabricate Titanium, page 63

Complete Table of Contents
. . . Inside Cover

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CIRCLE INFORM-A-GRAM KEY NO. 2

TOOLING & PRODUCTION Magazine

VOL. XXVI, No. 2

MAY 1960

FEATURES IN THIS ISSUE:

Reliability—A New Tool 9
Talk of the Month by Richard A. Landers

And The Greatest Of These Is Quality 41
Guest Editorial from the Cleveland Plain Dealer

Installing Quality Control 43
by Ralph B. Nottingham

Given the opportunity to start a Q-C program in a plant which has none, or to re-organize a weak one, what should you do? Here are some clues from a Q-C expert.

60" OD-ID Cylindrical And Face Grinder Tackles Large Bearing Rings 48
A description of the machine on the cover.

A Workable Quality Bonus Plan 49
by Frank L. Ross

"Money Talks," so why not link it with your Q-C program? That's what the author's company started, with profitable results. Read how.

Try Your Ideas With Plastic Models 51

Easy-to-make plastic models that simulate, during design stage, stresses set up in welded machine bases.

Avoid Tool Troubles By Proper Selection And Treatment of Tool Steels 54
by Arthur F. Torok

Tool performance depends on choice of material and treatment for the job at hand. Here are some keys to the elimination of tool steel headaches.

Tooling Up A Rotary Swager: Fourth of a Series 58
by Keith Bernhardt

A discussion of rotary swager die design.

Turn over for additional Contents . . .

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Pictures Show GE's High Accuracy Production Boring . . 61

A combination of tools and gages that help GE achieve jig borer accuracy on a production basis from a production boring machine.

Don't Wait For Tomorrow To Fabricate Titanium 63

by Burton Payne

Titanium isn't so difficult to work with if you follow the rules, as Pfaudler did when making an all-titanium pump.

Giant Turret Machine Uses 183 Spindles 70

Brief description of a Special that literally bristles with spindles.

SHORT ITEMS:

Spindle Exchange 22

Welds Coated Metals Fast and Easily 50

Machine Does Five Jobs In One Cycle 57

Earns Its Keep Through Versatility 66

Union Twist Imports Cutter Grinder Line 77

Shop Talk 77

Versatile Tool Cuts Grooved Hole Costs 84

DEPARTMENTS:

Personally Speaking 4
Men You Should Know 35
New Calling Cards 74
Catalogs—and other helpful literature 90
Product News 104
Cumulative Editorial Index.....132

BPA

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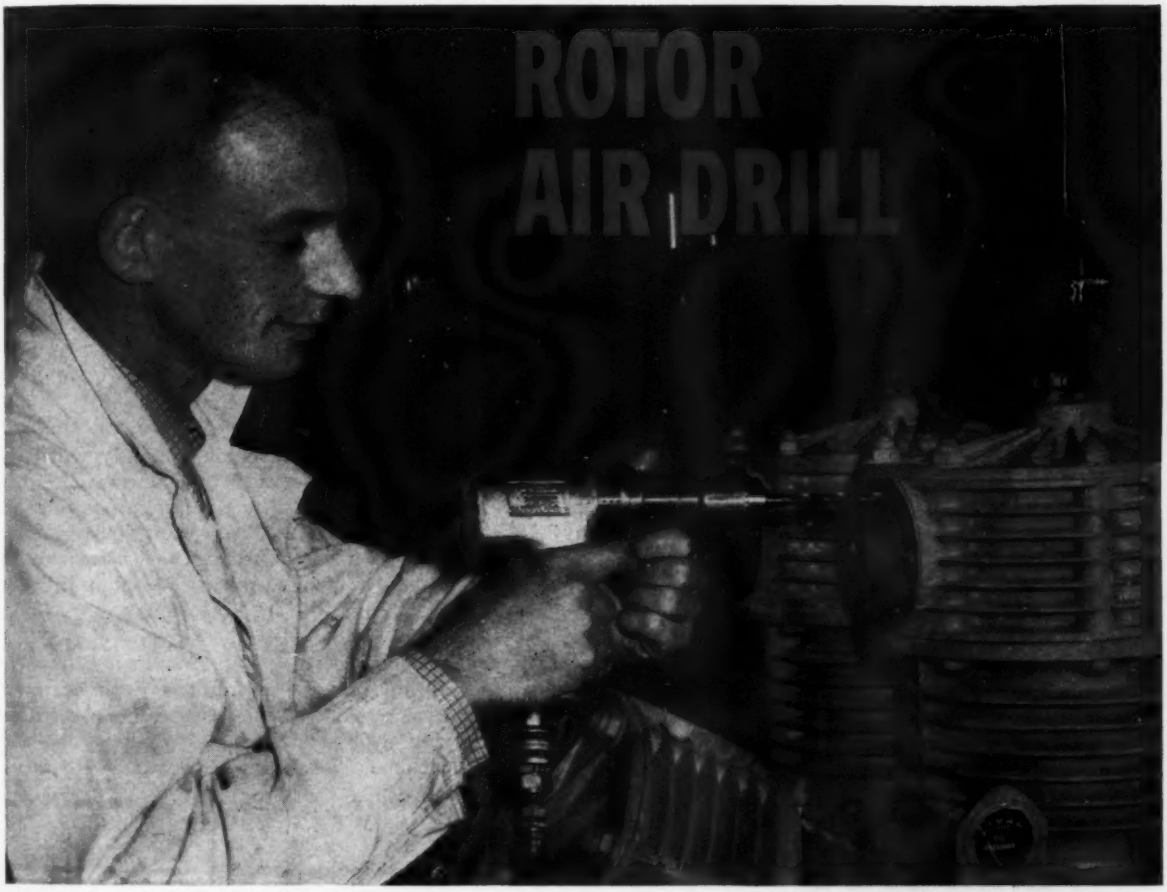

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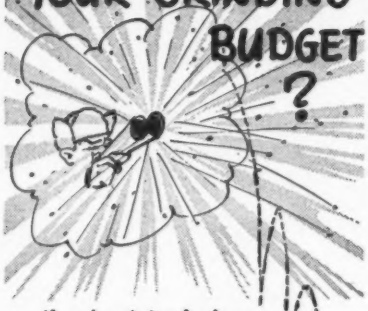

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CIRCLE INFORM-A-GRAM KEY NO. 4

MAY 1960
VOL. XXVI No. 2
GEORGE J. HUEBNER, Founder
1885 - 1956

personally speaking...

Dear T & P Reader:

Is your company holding off on placing orders for needed machine tools until you see what's new at the Machine Tool Exposition this fall? If it is, the chances are nothing will be accomplished except to delay just that much longer the date of delivery to you of those all important new machines.

There is considerable evidence that the market for standard machines of some types is seriously stalled in anticipation of the exposition. This does not seem to be the case, however, for machines that are special.

A week or two ago I got an incredible story of market stalling from one of the larger machine tool builders. It could be regarded as extreme exaggeration except for the unquestionable integrity of the source. The incident related to me occurred back in 1955 prior to the Machine Tool Show of that year. A quotation was made to a good customer nine or ten months before the show. No order was placed. Nothing happened until the show when this customer, after seeing this machine tool builder's show exhibit, handed him an order dated nine months earlier. Everybody lost on this incident.

A visit to the coming Machine Tool Exposition certainly will be a must for every machine tool user. Changes in machines from what you saw at the 1955 show will be striking, but the probability of your seeing anything spectacularly different from what you can order right now is very remote. If you have immediate needs, we suggest you reconsider any decision you may have made to wait until after the show.

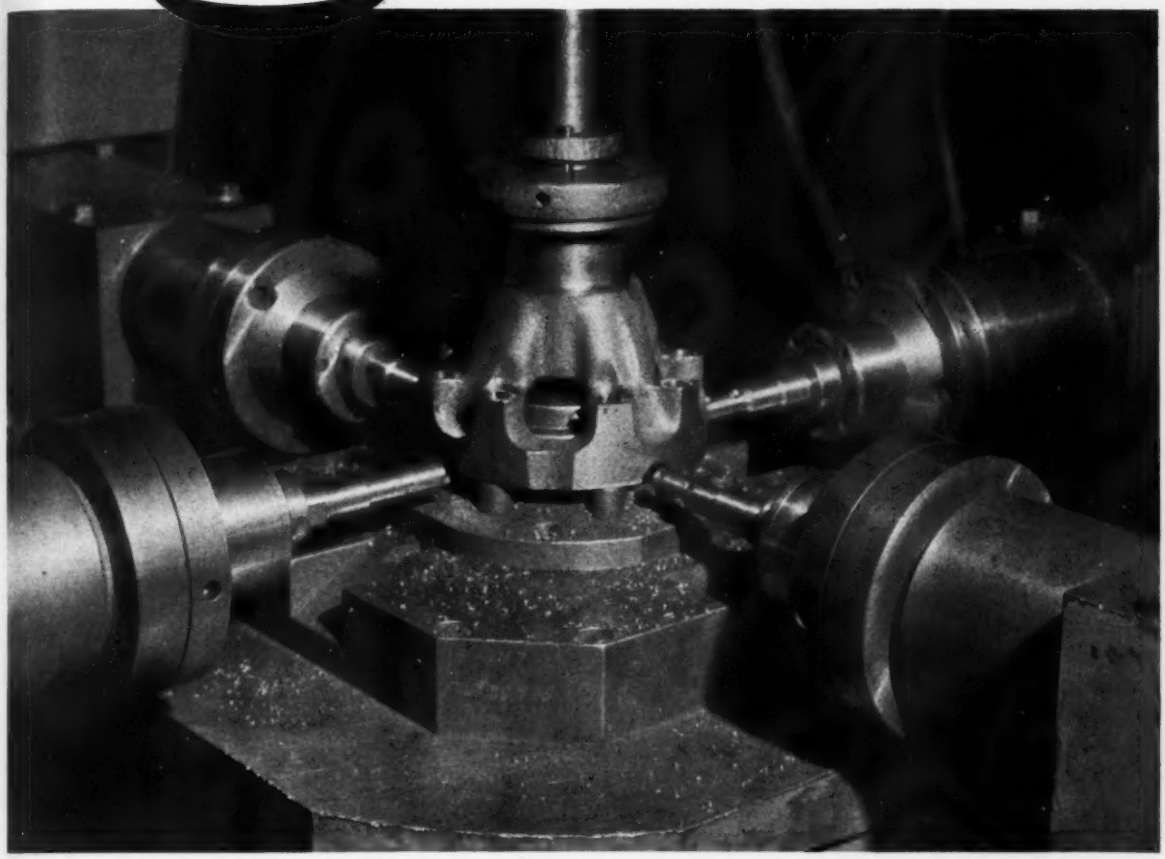
I had an interesting experience recently, — a ride in a Blimp. It's different from any other flying. All the flying I've done has been as a passenger, and my experience started on commercial airlines back when they were flying 6-passenger single engine wood and fabric planes with a crew of one. This Blimp ride was a real thrill. Try it if you get the chance.

Cordially yours,

Ray Huebner

Publisher

VR-65 Tungsten-Free Carbide



4 times more production!

The job is rough and finish boring half holes in a C5 steel forging. The machine is a 4 way Cross Bore operating at a speed of 2360 rpm and 700 sfpm; with a feed of .005 and a .025 to .030 depth of cut.

VR-65 tips are brazed to boring tools by conventional methods.

On this interrupted cut, VR-65 produced from 80 to 100 pieces per grind as compared to 10 to 25 pieces by previous conventional tungsten-base carbides.

VR-65 is the first of a new generation of carbides to provide ultra high speed machining on *all* types of steel . . . see your V-R representative for details or write:

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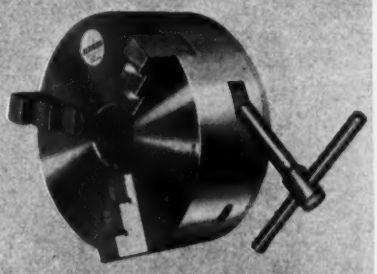
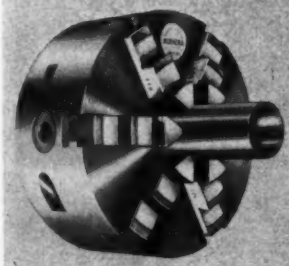


3- and 6-jaw GRIPTRU chucks

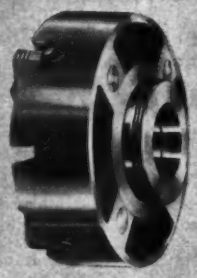
4" to 12" dia.

Concentricity within .0002" TIR!



Chucking work to within .0002" precision takes but one minute. Duplicate parts are chucked to same accuracy at scroll chuck speed. Meehanite bodies. *3-pinions.* Two sets solid jaws.

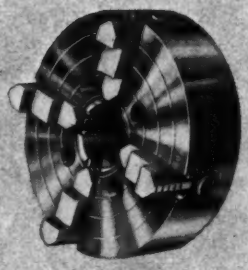
Available for direct mounting to long taper or D-1 cam-lock spindles, or, for backplate mounting.



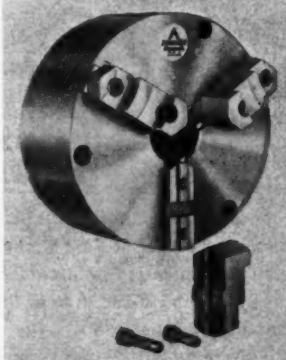
4-jaw heavy-duty independent chucks

6½" to 28" dia.

Have rugged Meehanite bodies, case-hardened ground steel jaws, large diameter case-hardened operating screws. Chucks 10" and larger have double thrust bearings.

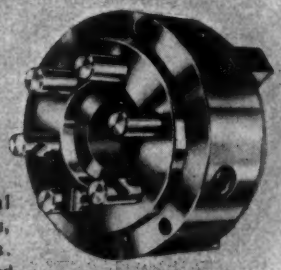


Available for direct mounting to long taper or D-1 cam-lock spindles, or, for backplate mounting.



3- and 4-jaw universal chucks

4" to 24" dia.



3- and 4-jaw universal chucks, like Burnerd Griptru, have Meehanite bodies. Scrolls are precision machined from heat-treated alloy steel. Pinions are case-hardened nickel steel—*there are three in each chuck.* Jaws are case-hardened, ground.

3-jaw chucks available with two-piece jaws or two sets of solid jaws—for direct mounting to long taper or D-1 cam-lock spindles, or, for backplate mounting.

336

BURNERD CHUCKS

CLAUSING DIVISION
ATLAS PRESS COMPANY
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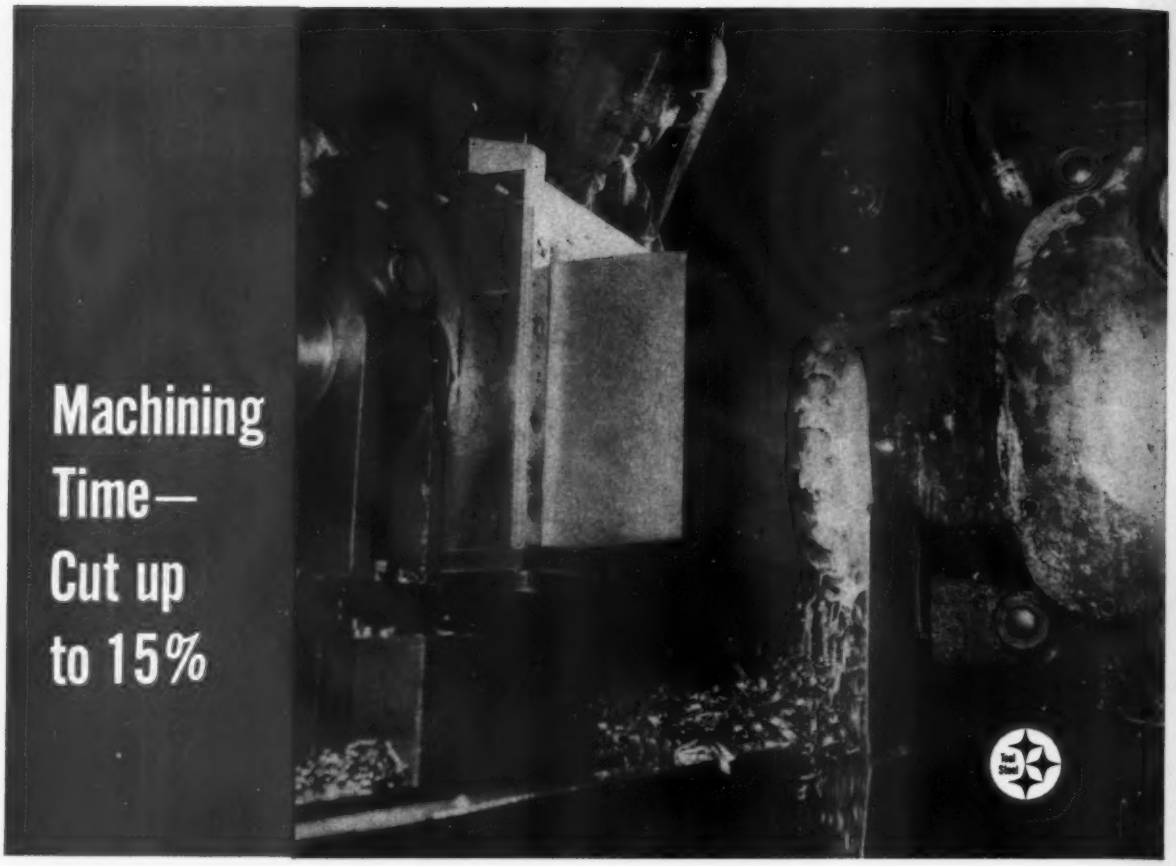

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In the production of thousands of metalworking dies, the properly dispersed alloy sulphides in Latrobe's FM High Alloy Die Steels have permitted increased feeds and speeds—*machining time cut up to 15% in most cases!* This cost-saving production is possible with no sacrifice of the excellent toughness, wear resistance and hardenability properties of the steel.

FM die steels are produced by Latrobe's Desegatized process of manufacture. This process guarantees full structural uniformity of the steel—an even distribution of the all-important carbide particles and "free-machining" alloy sulphides—your assurance of dependable quality.

Four grades of 12% chromium FM steels are regularly stocked: Olympic FM (type D-2) for long-run applications; BR-4 FM (type D-7) for extreme abrasion resistance; GSN FM (type D-3) for severe non-deforming requirements; Cobalt Chrome FM (type D-5) for extra resistance to galling and pickup.

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CIRCLE INFORM-A-GRAM KEY NO. 8

Talk of the Month

Reliability—A New Tool

by Richard R. Landers

IT IS NOT A simple task to design and make equipment to perform for long periods of uninterrupted service and achieve greater efficiency. The new specialization called Reliability Engineering is helping to achieve these ends.

Reliability Engineering is a separate phase of tooling endeavor. Working to customer specification is old stuff where we deal with weight, size and cost, but more and more we must consider endurance or reliability. A product's reliability has to do with it performing its function for a specified period of time in its intended environment.

Since there is every reason to believe that commercial equipment complexity will approach that of the military, let us examine reliability from the military standpoint.

A Navy survey disclosed that electronic equipment is inoperative more than two-thirds of the time.

Mr. Landers is Chief of Reliability at Thompson Ramo Wooldridge, Cleveland, Ohio. This article is excerpted from a paper he presented at the 17th Annual Design Conference of the Cleveland Engineering Society.

An Army survey revealed the startling fact that up to three-quarters of their electronic apparatus was either out of commission or under repair. An Air Force Investigation showed that during a five year period the maintenance and repair cost for their electronic equipment was more than 10 times the original cost. Right now, because of unreliability, the military is adding to its $20-billion stores at the rate of $2-billion a year.

It is generally accepted that reliability of a product cannot be any better than that which is inherent in its design. Manufacturing—no matter how skillfully performed—can do no better than preserve the reliability already dictated by selection and application of the parts making up a product. Consequently, if a specified degree of reliability is to be attained, it must be planned for. All subsequent efforts after planning merely maintain or bring about inherent reliability.

Until recently we had the materials and the know-how to build

. . . **Continued on page 13**

Higher-speed operation from built-in gauging

New cam-lever linkage of the Di-Acro Model 36 shear provides a greater mechanical advantage than lever actions. This makes it easier to control both machine and material so that operation is easier, faster and safer.

Quick-Set micrometer gauges set to hair-line accuracy in seconds. The new Model 36 shear is fast to set-up, fast to operate. To maintain tolerances to thousandths of an inch, an automatic hold down bar grips materials during shearing. Notching and slitting can be done easily by setting the adjustable ram stops to limit stroke length. Capacity of the machine is 16 gauge steel.

Steel, rubber, mesh and all shearable sheet materials (even some plastics) can be cut to die-accuracy with the new Model 36.

Similar performance is also delivered by a range of other models down to 6 inches in width. For detailed information, call your Di-Acro distributor who is listed in the yellow pages of your phone book under Machinery—Machine Tools, or write us.

DI-ACRO POWER SHEARS. Di-Acro Shears of 12" and 24" widths are available in power models. The standard model provides continuous and single stroke operation. Vari-O-Speed model shears automatically at a range of speed from 30 to 200 R.P.M. or single stroke.

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pronounced "die-ack-ro"

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Throw those old-fashioned collets away!

Now you can afford to equip your
Atlas SHELTON DELTA SOUTH BEND Logan
lathes with the world's most modern
collet chuck and its Rubber-Flex® Collets

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Model 50
Collet Chuck

$65.00
Complete Set of
10 Rubber-Flex Collets

You get a lot more for less!

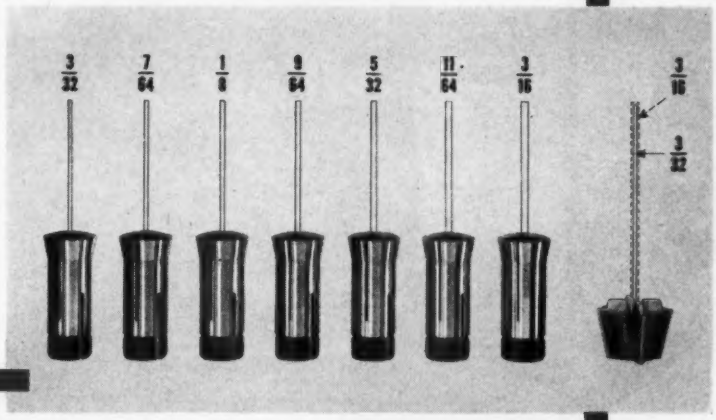
model 50

- is a brand new nose type handwheel chuck
- is quicker to operate
- is easier to operate
- is more accurate
- develops more torque
- increases lathe capacity
- mounts directly onto your spindle
- costs less . . . less . . . less . . .

A lot more for a lot less...

$70.00
for the chuck!

$65.00
for the collets!
($6.50 each)



An entirely new series of ten Jacobs Rubber-Flex Collets has been developed along with the world's most modern collet chuck. Rubber-Flex collets do more because:

- **Jaws are always parallel for greater accuracy . . . maximum runout .001".**
- **Extra long bearing surfaces have stronger grip.**
- **Only 10 collets chuck all bar sizes—3/32" to 1 1/16"—.100" range per collet.**

How one Rubber-Flex collet replaces seven split steel collets

This is the chuck,
these are the collets,
for your . . .

ATLAS • DELTA • LOGAN
SHELDON • SOUTH BEND
. . . lathes

See your Jacobs industrial supply distributor. Let him prove these fantastic facts with a convincing demonstration at your desk! Call him today.

Jacobs CHUCKS

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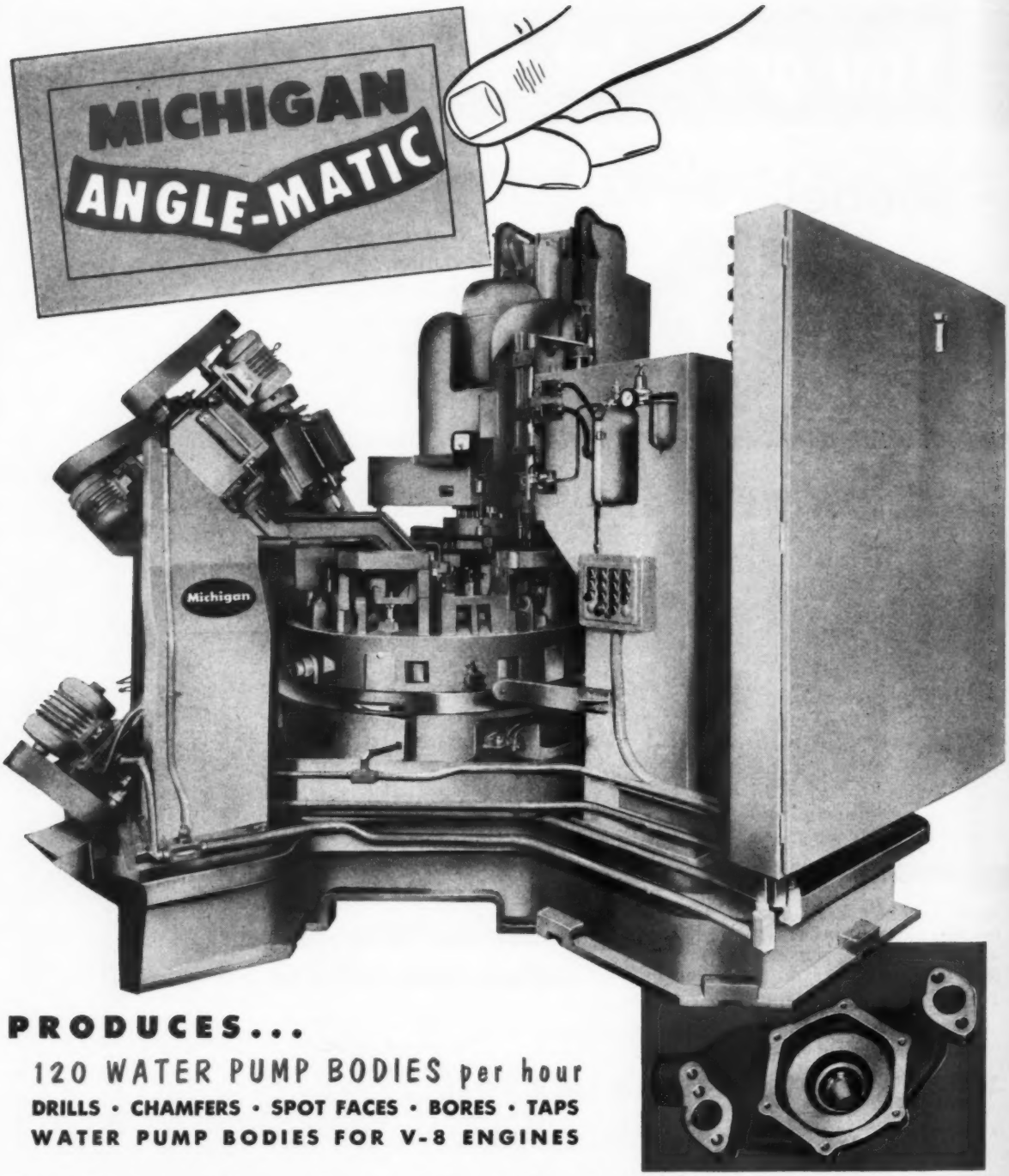
MICHIGAN ANGLE-MATIC



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Engineers and Manufacturers of High Production Metal Cutting Machines and Components.

CIRCLE INFORM-A-GRAM KEY NO. 12

. . . **Month's Talk from page 9**

almost any equipment we could conceive. In addition, man could understand, operate, and control these products with reasonable ease. But lately, with our exploding technology, we are calling for materials and designs only one short step removed from the research program. Some of this equipment is beyond the comprehension and handling ability of the average operator. This means that the task of operation and control must be done by equipment even more complicated. We are approaching an era of machines which diagnose and repair their own malfunctions.

"Why do we need compartmentalization in planning groups to achieve reliability in our products?" The answer involves time and cost.

We may define Reliability Engineering as that specialized effort which will achieve an output in one unit of time and for one dollar that ordinarily would take many units of time and many dollars. It should not be inferred, however, that a reliability program is cheap. Quite to the contrary, an effective reliability program normally calls for an expenditure of 20-30% of the total development cost.

How, then, do we explain this apparent paradox? Where do savings come from? Let's consider an example: It is traditional in the automotive industry to build 100 or more cars to be run to destruction, for evaluation. No one questions the value of this practice for debugging prior to full scale production. However, in the case of a commercial jet transport, the tremendous cost precludes building even one plane for destructive testing.

If it is better cost-wise and time-wise to design the product better the first time, what are some of the services a formalized reliability group can offer during initial phases of development? They are: Contract Review, Reliability Prediction and Analysis, Environmental Analysis, Parts and Design Standardization, and Design and Specification Review.

Contract Review

There is a growing tendency toward specifying quantitative reliability requirements in equipment contracts. These involve various endurance capabilities of equipment, such as its total useful life, average time between failures, time between overhaul periods, shelf life, and in some cases maximum repair or recovery time in the event of failure.

Two things become obvious when specifications like these are considered. First, reliability requirements will not be achieved by wishful thinking, nor can they be attained if the engineer does not specifically take them into consideration in the first place.

Second, there is an interrelation between weight, size, performance of equipment, and endurance capabilities. For example, making equipment smaller may reduce its weight but it may also decrease its reliability. In other cases reliability can be increased by using redundancy techniques, at the penalty of increased size. There are also interrelations between the endurance capabilities themselves. For in-

. . . **Continued on page 14**

2739

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PRECISION HOLES
ON THE

Hamilton

SUPER SENSITIVE TAPPING MACHINE

(000 - 120 to 10 - 24)
"It masters the heart-break jobs"

Ask for
FREE LITERATURE BATCH
No. T-821

THE HAMILTON TOOL COMPANY
832 SOUTH NINTH STREET · HAMILTON · OHIO

CIRCLE INFORM-A-GRAM KEY NO. 13

PRECISION PRODUCTION PROBLEMS?

Here's help from Bausch & Lomb

in TOOL DESIGN
INSPECTION
FABRICATION
MEASURING
TESTING

TOOLMAKERS' MEASURING MICROSCOPE

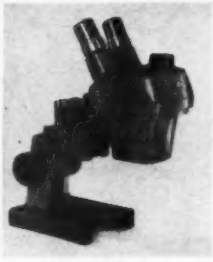
Quickly measures transparent or opaque objects of any contour. Linear, accurate to 0.0001"; angular, to 1 minute of arc.

NEW UNIVERSAL STAGING FIXTURE

Positions small parts for critical measurement with B&L Bench Comparator and Toolmakers' Microscope. Auxiliary base, with 7" travel, increases range beyond that of measuring stage.

STEREOZOOM* MICROSCOPES

Magnified 3-D views of tiny parts. Dustproof, shockproof, can be mounted right in machine or fixture. Speeds assembly, inspection. Most complete line, widest field of view.

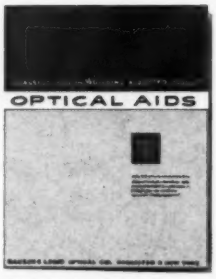


BENCH COMPARATOR

Exclusive understage illumination—no complex set-ups, no holding fixtures for most work. Magnified silhouettes, show errors instantly. Reads to 0.0001" with optional micrometer stage.

OPTICAL AIDS CATALOG

Time-and-money-saving data on Surface Comparators, Industrial Magnifiers, Macroscopes, Micrometer Discs, Brinell Microscopes, Microscope Bodies, Wide Field Tubes, Shop Microscopes.



NEW SCRATCH-DEPTH GAGE

With this simple hand-held instrument you can measure the depth of any scratch to 0.0001", with a range of 0" to 0.015"

*TRADEMARK, BAUSCH & LOMB OPTICAL CO.

MAIL COUPON TODAY FOR VALUABLE DATA

BAUSCH & LOMB OPTICAL CO.
77305 Bausch St., Rochester 2, N. Y.

Please send literature on optical production aids checked below:
☐ Toolmakers' Microscope ☐ Scratch-Depth Gage ☐ Bench Comparator ☐ Optical Aids Catalog ☐ StereoZoom* Microscopes ☐ Universal Staging Fixture.

NAME .....
TITLE .....
COMPANY .....
ADDRESS .....
CITY ..... ZONE ..... STATE .....

BAUSCH & LOMB
SINCE B&L 1853

CIRCLE INFORM-A-GRAM KEY NO. 14

. . . Month's Talk from page 13

stance, we may tolerate more failures in equipment that is easily repaired.

Reliability Prediction

Reliability prediction for a unit involves the statistical analysis of individual component failure rates. The sum of these component failure rates equals the unit failure rate. In many cases prediction techniques have discrepancies between specified reliability values and the overall reliability expectations based on capabilities. In these cases, there are several alternatives. Redundancy may be employed to increase the mean-time between failure; new or fewer component parts may be selected; or, in the face of physical design limitations, a reliability improvement program is set up. A developmental schedule or reliability growth curve is established using reliability analysis techniques. This provides criteria for periodic checking of equipment to determine if it is improving at a rate sufficient to meet contract requirements.

Environmental Analysis

Environmental analyses were performed long before reliability engineering emerged as a separate discipline. Specialized test facilities, data reduction equipment, and analytic skills required, are not found outside a reliability group, however.

The close relationship between failure rates and the results of environmental analysis is logically assigned to the Reliability Group. For example, the failure rate of a given component can be cut in half by reducing its ambient temperature 40°. If, however, the temperature could not be reduced, then the unreliability contributed by the component can be somewhat compensated for by increasing the reliability of another component—like improving vibration isolation. This subtlety goes beyond the previously either-it-works-or-it-doesn't consideration.

The task of determining the nature and extent of environment increases in complexity at the same rate as the equipment itself. Along with vibration, shock, and temperature extremes, equipment is now

. . . Continued on page 19

Better RED RING tooling
through intensive research

A new COMPUTER (the latest BENDIX Alpha-Numerical type) has enabled us to greatly accelerate our continuing program of basic research in both gear and broaching practice.

Another important advantage of this equipment is utilized in the day to day design of individual shaving cutters and honing tools to meet certain specified operating conditions. With the computer, all of the many design possibilities are rapidly evaluated in order to be sure of the very best selection.

Red Ring engineering know-how plus high-speed electronic calculation is your assurance of the most effective tooling for your own production needs.

SPUR AND HELICAL GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING,
GEAR HONING AND ELLIPTOID

Write for Bulletin CAP 57-11

NATIONAL BROACH & MACHINE CO.

5600 ST. JEAN • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

CIRCLE INFORM-A-GRAM KEY NO. 15

HERE IS THE GRINDER YOU ASKED FOR!

● A smaller (14" x 42" or 14" x 48" table) heavy duty, high precision surface grinder with controls at eye level retaining all the features that have made HILL horizontal spindle hydraulic surface grinders famous for precision production during the past twenty years. This is an entirely NEW grinder brought out at your request to compliment the line of HILL heavy duty surface grinders of larger sizes. Where initial cost and limited floor space are critical factors we believe that this new, smaller HILL grinder will solve your finer finishing problems. Full details are given in bulletin 58GS.

HILL Horizontal Spindle grinder with fully hydraulic table and cross feeds. Size: 14" x 42" table with 16" clearance. Magnetic chuck is standard equipment.

Of course we still make the full line of HILL horizontal spindle and vertical spindle grinders in the larger sizes with table lengths from 5 to 20 feet.

HILL ACME TOOLS FOR INDUSTRY

Manufacturers of: "HILL" Grinding & Polishing Machines — Hydraulic Surface Grinders — "ACME" Forging — Threading — Tapping Machines — "CANTON" Alligator Shears — Billet Shears — "CLEVELAND" Knives — Shear Blades

THE HILL ACME COMPANY

1207 W. 65th STREET
CLEVELAND 2, OHIO

CIRCLE INFORM-A-GRAM KEY NO. 16

Want to save with plastic tools and dies?

Your EPON® RESIN tooling formulator can help you

Tools and dies made of tough but easy-to-handle Epon resin can save you up to two thirds in time, one third in cost! Your tooling resin formulator will show you how Epon resin formulations are saving time and money—*right now*—in applications such as:

High-temperature tooling: Metal-forming stretch dies that can operate at temperatures over 400° F.

Heated tools: Matched dies, with integral heating units, may be made with Epon resin formulations for rapid heat-curing of laminated plastic parts.

Long-lasting metal-forming tools: Castings made of formulated Epon resin, mounted in a crank press, showed no permanent deformation after 28,000 compression-shock cycles.

For tool and die applications, Epon resin formulations offer you the following important advantages:

Excellent tolerance control: Little machining and handwork are required to finish Epon resin tools because of the material's excellent dimensional stability and lack of shrinkage.

Outstanding strength: Jigs and fixtures with thin cross sections can be built from Epon resin-based formulations reinforced with glass cloth. The resulting laminate has high flexural strength and excellent dimensional stability.

Easy modification: Tools and fixtures made from Epon resins may be quickly and easily modified to incorporate design changes.

CONTACT YOUR TOOLING RESIN FORMULATOR

The combination of resin formulator's skill and application knowledge, backed by Shell Chemical's research and resin experience, has solved many important tooling problems for industry. For a list of experienced tooling resin formulators and additional technical information, write to:

SHELL CHEMICAL COMPANY
PLASTICS AND RESINS DIVISION
110 WEST 51ST STREET, NEW YORK 20, NEW YORK

Central District
6054 West Touhy Avenue
Chicago 48, Illinois

East Central District
1578 Union Commerce Bldg.
Cleveland 14, Ohio

Eastern District
42-76 Main Street
Flushing 55, New York

Western District
10642 Downey Avenue
Downey, California

IN CANADA: Chemical Division, Shell Oil Company of Canada, limited, Toronto

SHELL

CIRCLE INFORM-A-GRAM KEY NO. 17

WE MAKE SURE
PIPE MACHINERY
GAGE MATERIALS GET
THE BEST TREATMENT

At Pipe Machinery, years of experience has taught us the best treatment for each of our gage materials. Leaving nothing to chance, we maintain our own heat treating department where this special "know-how" can be properly exploited. The High Speed Steel used for all plug gages through one and one-half inches as well as other gage metals are carefully heat treated under the most rigid quality controls – to assure accuracy and long wear life for the finished product.

Are you certain you're getting the best material and heat treatment in your gages? If they're from Pipe Machinery, the answer is an emphatic yes!

For further information on our complete line of quality gages, write us on your letterhead today.

THE PIPE MACHINERY COMPANY • 29100 Lakeland Boulevard • Wickliffe, Ohio • Greater Cleveland

CIRCLE INFORM-A-GRAM KEY NO. 18

. . . Month's Talk from page 14

subject to the effects of electromagnetic fields and deterioration from clear radiation.

Parts and Design Standardization

Standardization programs involve the selection, qualification and application of component parts. Planning statistical testing to qualify parts assures that complete data be collected in an economical manner.

Design standards are prepared and sent to engineers along with component part standards. This practice encourages the use of proven parts and properly evaluates new parts for inclusion if design-stagnation is to be avoided. Along with dimensional and performance data, reliability information is also provided for each part. This includes such things as derating curves, failure rates, and application pitfalls.

Unless a concentrated standardization effort is made, there is a tendency for designers to select their own favorite parts, which are not necessarily reliable. Standardization further provides the economy of quantity purchases, standard tooling, common stocking, and reduced special training for personnel handling or repair.

Design and Spec Review

One of the most effective tools in the Reliability Engineer's kit is the scheduling and conducting of design and specification reviews.

During the design phase, three reviews are generally held: the first at initial layout, the second midway through design, and the third when the design and/or first prototype is completed.

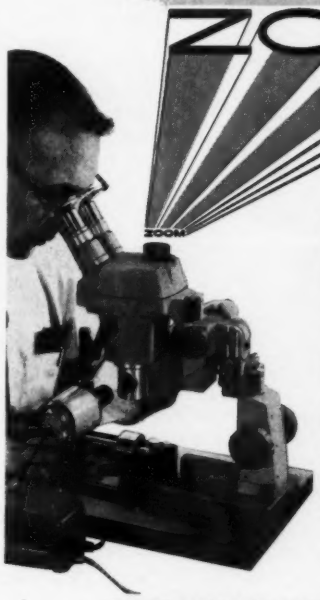
It has been found that a checklist is an effective aid in conducting design reviews. Hundreds of items can be covered in a short time and will insure complete coverage of reliability as well as other factors.

It is advantageous to have a formal review board with representation from the Reliability Group, Development Engineering, Quality Control, Field Service, and Manufacturing.

Test and manufacturing specifications, should also be reviewed for completeness and accuracy to assure that reliability is not degraded during production and testing.

. . . Continued on page 22

Selling FASTER than any microscope in history!



ZOOM

NEW STEREOZOOM* MICROSCOPES BY BAUSCH & LOMB!

Breaking all sales records! Just try one in a free shop demonstration and you'll soon see why . . . they're the newest step forward to faster and easier 3D work.

EXCLUSIVE NEW OPTICS!

Get StereoZoom...continuously variable power! Just a turn of the knob gives an infinite choice of magnifications throughout the whole stereo range . . . to 120× on some models.

EXCLUSIVE NEW POWER POD DESIGN!

A wholly enclosed optical system in a single unit. Keeps out dust and dirt; eliminates old fashioned nosepieces, annoying image jump and blackout. NEW VERSATILITY, TOO! Your choice of StereoZoom or fixed power in a Power Pod that interchanges among any of five basic stands.

NEW LOW PRICE! About ⅓ lower than previous line.

*Trademark, Bausch & Lomb Optical Co.

BAUSCH & LOMB SINCE 1853

BAUSCH & LOMB OPTICAL CO.
79705 Bausch St., Rochester 2, N. Y.

☐ Send me new B&L StereoZoom Catalog D-15.
☐ Schedule a demonstration at my convenience.

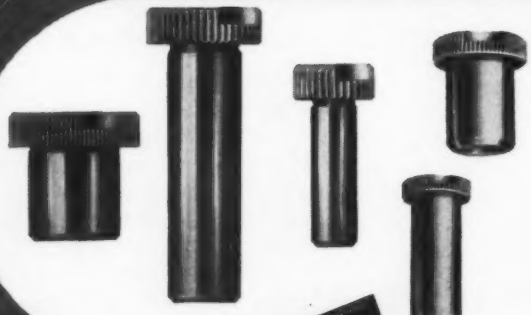
Name, Title.....
Company.....
Address.....
City..... *Zone*..... *State*.....

CIRCLE INFORM-A-GRAM KEY NO. 19

you get close tolerance drilling with
UNIVERSAL DRILL BUSHINGS

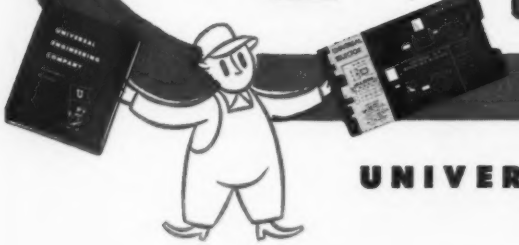
Accurately machined bushings are essential when drilling to close tolerance. UNIVERSAL DRILL BUSHINGS, of finest quality steel, are carefully tested for 100% concentricity and hardness, assuring pin-point accuracy and uniform quality. To prevent tool hang-up and breakage, each bushing has a blended radius on the top inside diameter.

All bores are superfinished. This superfinishing of bushings is important, especially in close tolerance work, because it reduces both tool and bushing wear to a minimum. Knurled head gives a quick, sure grip.



We stock drill bushings in all standard sizes and lengths at each of the following offices—Universal Engineering Sales Co., 1060 Broad St., Newark 2, New Jersey; 5035 Sixth Ave., Kenosha, Wis., and at our home office in Frankenmuth. Contact the nearest office for immediate delivery.

The Universal Drill Bushing Slide Chart gives accurate engineering data for the selection of all types and sizes of drill jig bushings up to 1¾" drill size. You may have one—free—by requesting on your company letterhead. At the same time, get your copy of our new catalog that describes all of UNIVERSAL'S products including chucks, tool holders, boring bars, bushings and index plungers.



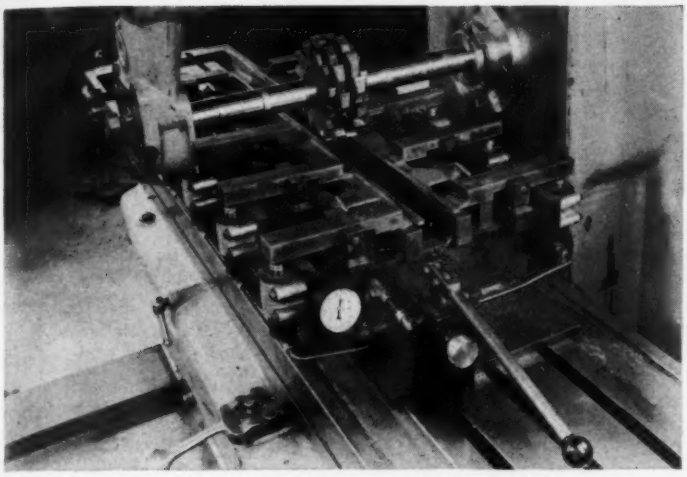
UNIVERSAL ENGINEERING COMPANY

FRANKENMUTH 8, MICHIGAN

207

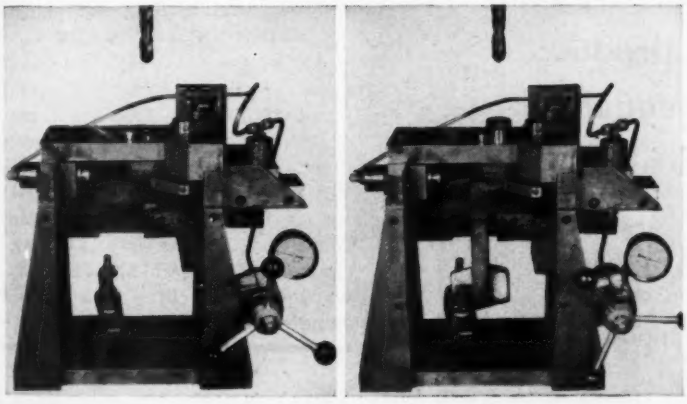
CIRCLE INFORM-A-GRAM KEY NO. 20

How other shops clamp down on loading time...



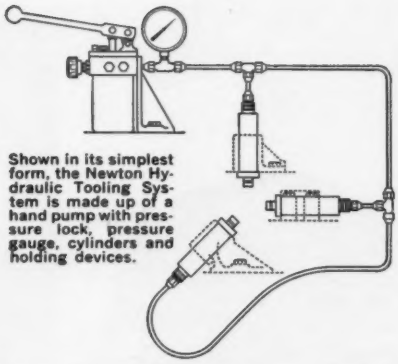
TRIANGLE PACKAGE BOOSTS PRODUCTION 335% . . .
reports Michael Zolnierczyk, Triangle Tooling Supervisor. Former floor-to-floor time, using mechanical clamping, averaged 57 minutes per piece or over 142 hours per 75 pairs. With Newton Hydraulic System, average floor-to-floor time has been cut to 17 minutes per piece, or 42 hours per 75 pairs, including set-up time. "The above figures," states Mr. Zolnierczyk, "represent a saving of 40 minutes per piece part, which is a production gain of 335%." Photo above shows Newton Hydraulic Tooling System installation machining fragile guide rails for conveyor system of meat packaging machine.

(The Triangle Package Machinery Company, Chicago, Illinois, manufactures filling, packaging and wrapping machines of particular importance to the food industry.)



R & H MACHINE SERVICE CLAMPS ODD-SHAPED PARTS RAPIDLY . . .
according to Robert Miller, Chief Engineer, who says: "The new Newton Hydraulic Clamping System is readily applied to a drilling jig for an odd-shaped casting, which would be awkward to clamp by other methods. Shown above are views before and after the part is positioned for drilling." Adds Mr. Miller, "Clamping and unclamping are far more rapid than would be possible with manual clamps. Pressure is uniform regardless of small variations in the size of castings or parts. Economy is another advantage. All the units, with the possible exception of some of the piping, can be used over again on other jigs and fixtures."

(R & H Machine Service, Cincinnati, Ohio are special machinery and tool builders.)



Shown in its simplest form, the Newton Hydraulic Tooling System is made up of a hand pump with pressure lock, pressure gauge, cylinders and holding devices.

Newton Hydraulic Clamping can speed up your production, too . . . . .

Newton System permits rapid operation of clamps in jigs and fixtures in a matter of seconds compared with the minutes lost by mechanical clamping. System consists of actuating pump feeding a number of clamping cylinders with hydraulic fluid under pressure. Extremely versatile, any number of cylinders usable up to pump's capacity. Various clamping positions facilitated. Pre-determined line pressures up to 2500 psi, are rigidly controlled. System provides easy, safe operation in confined work areas. Entirely self-contained unit. Screw or lever pumps, equipped with pressure locks, available in 2 sizes. Cylinders in varied size ranges. Hydropneumatic intensifiers also available for utmost clamping speed.

HYDRAULIC SYSTEM ASSURES:

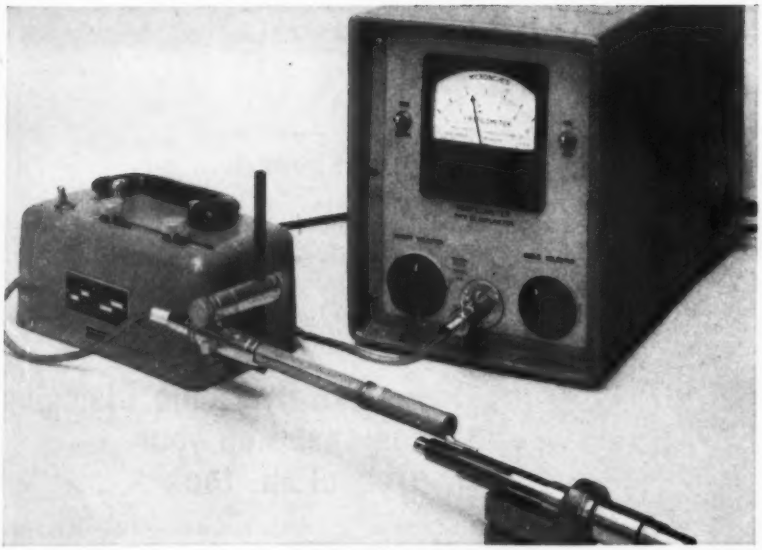
- **Maximum reduction in clamping time**
- **Multiplicity of clamping positions**
- **Fast clamping of odd-shaped parts**
- **Controlled clamping pressures**
- **Decidedly safe, economical operation**
- **Movable self-contained units — independent of outside power**
- **Wide range of pumps, cylinders, and mounting devices**

A Newton engineer will be pleased to show you the efficiency and economy found in hydraulic clamping. Simply fill out and mail the coupon below.

NEWTON
HYDRAULIC TOOLING CO., INC.
AUBURN, MASSACHUSETTS

NEWTON HYDRAULIC TOOLING CO., INC., AUBURN, MASS.
I would like more information about Newton Systems.
☐ Send literature ☐ Send representative
NAME & TITLE:_____
COMPANY:_____
ADDRESS:_____
CITY:_____ STATE:_____

CIRCLE INFORM-A-GRAM KEY NO. 21



PERTINENT QUESTION:

WHEN do you need the Profilometer®?

FACTUAL ANSWER:

Whenever you must precisely *know* the roughness of *any* production surface — quickly, dependably, in microinches (arithmetical or rms).

FREE BULLETIN LT14 gives details — describes cost-saving applications. May we send you a copy?

MICROMETRICAL MMC MANUFACTURING COMPANY
345 S. MAIN ST. ANN ARBOR 6, MICHIGAN

Manufacturer of the PROFILOMETER®, PROFICORDER®, MICROCORDER®, WAVOMETER®, ANDEROMETER®, VAROMETER®, CHART VIEWER • Exclusive American Sales Agent for CENSOR Dimensional Gaging and Sorting Equipment

CIRCLE INFORM-A-GRAM KEY NO. 22

. . . Month's Talk from page 19

Support Functions

In addition to the major functions, there are support functions useful within the Reliability Group. These include Human Factors, Operations Research, Value Analysis, Logistics Engineering, and Statistical Design of Experiments. On truly complex equipment these are not luxuries, but necessities.

Merely having these specialized disciplines available is not enough; engineers are basically do-it-yourself individuals. Consequently, they must be convinced they can benefit from special assistance. Often they feel that it is an admission of inadequacy to call upon the services of specialists.

In fact, Reliability Engineering as a whole may be treated as an unwelcome intruder and a threat to the engineer's independence. This is not true. The engineer, in the final analysis, is the only one who can be held responsible for the reliability and general integrity of the product. Reliability, Operation Research, and Human Factor people are there only to assist in production.

Our exploding technology has made this task so complicated that no one individual could ever possibly hope to master all of the disciplines required.

Spindle Exchange

An expanded spindle exchange plan, offered by Bryant Chucking Grinder Co., Springfield, Vt., permits trading worn-out or obsolete high frequency spindles (both Bryant and competitive models) for up-to-date 300 Series Bryant spindles. It features a $100 exchange or trade-in-allowance toward the price of a new Bryant spindle.

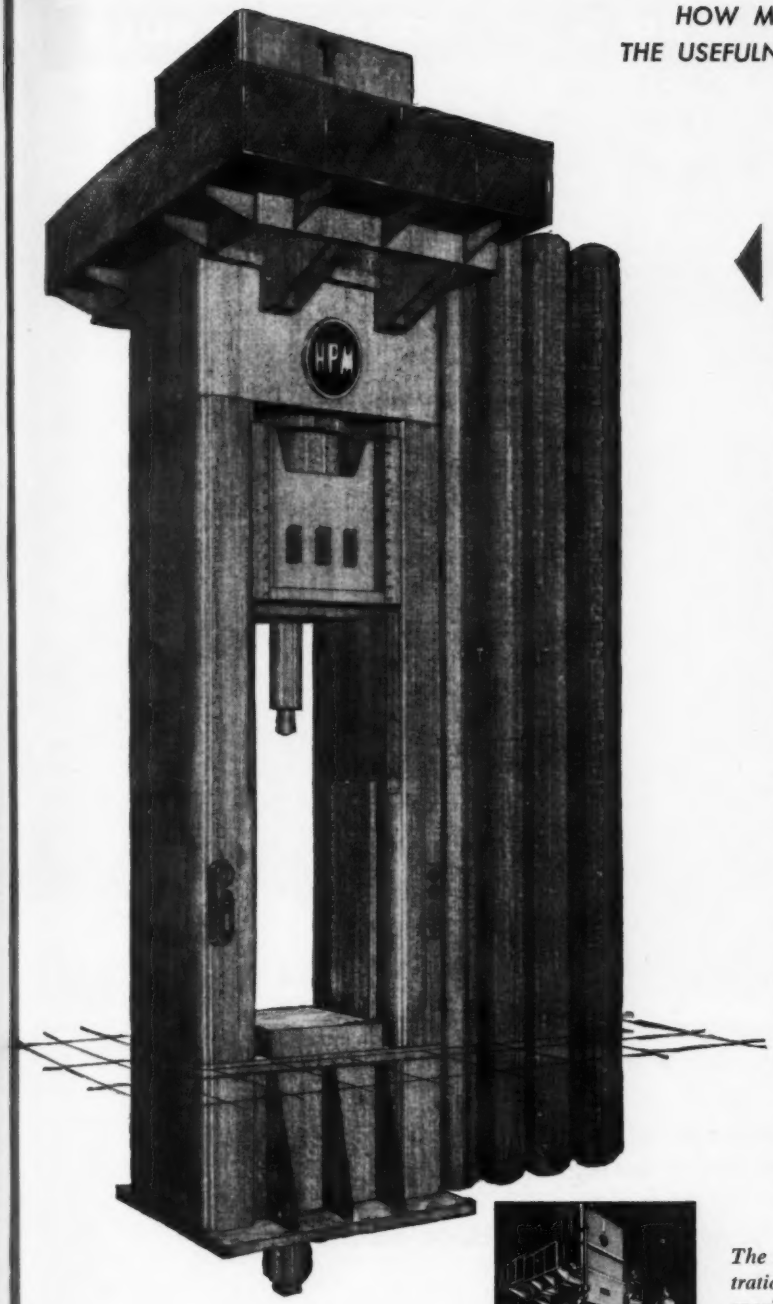
Deaths

Harry Pelphrey, 58, director of research of Michigan Tool Co., died Feb. 18 at Mt. Carmel Hospital, Detroit.

Ben Paulsen, 69, president of B. R. Paulsen & Co. and Milled Screw Products Co., died March 4, in Golden Beach, Fla.

Albert E. Forberg, 73, sales engineer for National Broach & Machine Co., died March 6.

HOW MODIFIED H-P-M STANDARDS TRIPLE THE USEFULNESS OF METALWORKING PRESSES



TOO CUSTOM TO CATALOG

But Just Right For The Job

The sketch at left emanated from the proposal engineering department at H-P-M and a few months later the press, shown in the small photo below, became a reality. It was designed for a combination of hot forging and cold extrusion and incorporated enough unusual press requirements to qualify as special. This 1000-ton H-P-M has a bed area of 66″ x 60″, 98″ of daylight and a 60″ stroke. It is equipped with a 150-ton hydraulic ejector cylinder with a 24″ stroke. The main ram travels at a speed of 1000 ipm for closing and return with a pressing speed of 600 ipm. The accumulator system shown at right supplies a high speed pressure stroke of 19″ in length.

Completely special as normal requirements go but a pressure processing problem that's a typical standard for H-P-M engineers. Both the engineering ability and the facilities to manufacture such huge equipment make H-P-M your best source for metalworking machines of the future.

You're under no obligation to investigate the service that H-P-M has been performing for years — special hydraulic design for the metalworking industry. Write or call for complete details.

The design sketch illustrated is a perspective illustration that accompanies each H-P-M proposal for special machine recommendations. These portfolios contain complete job recommendations, layout drawings, press specifications, delivery and price. It's a service that is backed by thousands of engineering hours from our experienced staff of hydraulic specialists.

THE HYDRAULIC PRESS MANUFACTURING COMPANY
A Division of Koehring Company • Mount Gilead, Ohio, U.S.A.

H71

CIRCLE INFORM-A-GRAM KEY NO. 23

YESTERDAY'S PIONEER . . . TODAY'S LEADER

EXPERIENCE / THERE IS NO SUBSTITUTE!

OVER 40 YEARS OF LEADERSHIP SINCE 1918

40 years' successful experience as a company in the manufacture of cutting tools means that when you buy Weldon tools you are assured of the finest.

For all of these years we have consistently led the field in the origination and production of the highest quality end mills, holders and allied items.

Specialization for 40 years—that is the Weldon record—and the best of cutting tools is the result.

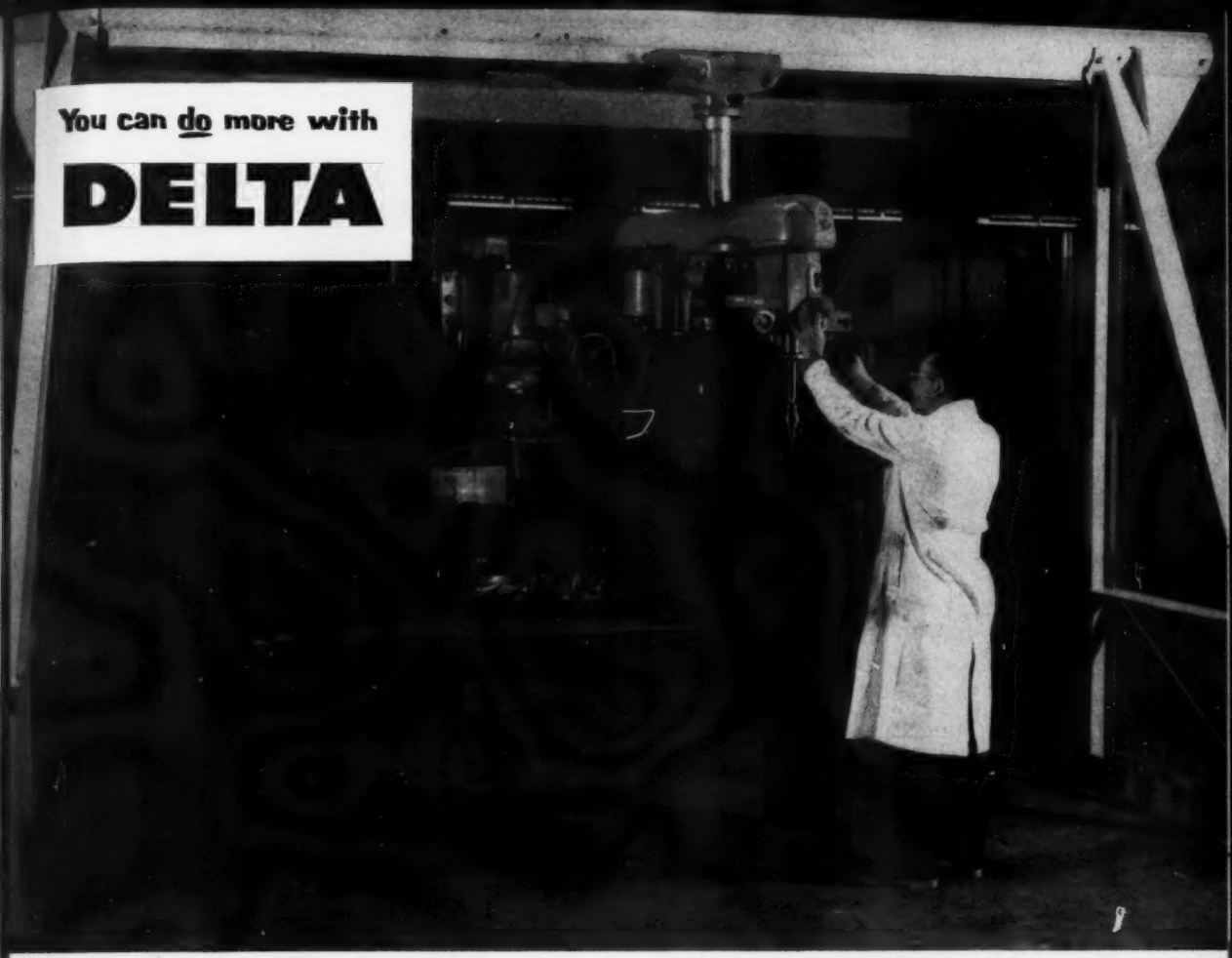
Catalog list numbers are now marked on all Weldon tools and holders as an aid when reordering . . . another WELDON FIRST.

Weldon distributors throughout U. S. A. and Canada carry complete stocks to serve you. EX2

THE WELDON TOOL COMPANY

3000 WOODHILL ROAD . . . CLEVELAND 4, OHIO

CIRCLE INFORM-A-GRAM KEY NO. 24



NEW: "Big" drilling jobs made easy

Delta 20″ Drill Press, also 17″, 15″, 14″ and 14″ Super-Hi Sensitive. Available in floor, bench and multiple spindle models.

This custom "radial drill" is provided by combining standard Delta drill press components—an 8-ball bearing traveling carriage, husky 33″ column, raising mechanism and choice of four Delta 20″ drill heads. Suspended from an overhead trackway, it swings to any position over the work—handles jobs too big for conventional drilling, in production runs too small to justify an expensive machine tool.

But whether your production requirements call for special setups or standard tooling, you'll find that Delta drill presses offer you money-saving versatility and precision performance under the most rugged work loads. Delta drill presses have set the industry standard for years because they cost less to buy, operate and maintain.

Choose from the world's most complete drill press line—visit your Delta Industrial Distributor (listed under "TOOLS" or "MACHINERY" in the Yellow Pages). For FREE Delta Industrial Catalog showing 61 machines, 302 models, over 1400 accessories, write: Rockwell Manufacturing Company, Delta Power Tool Division, 622E N. Lexington Ave., Pittsburgh 8, Pa. In Canada: Rockwell Manufacturing Company of Canada, Ltd., Guelph, Ontario.

DELTA INDUSTRIAL TOOLS

another fine product by

ROCKWELL

CIRCLE INFORM-A-GRAM KEY NO. 25

Thor

Everything you want in Air Hoists . . .

and more!

Put a 30 lb. air hoist to work for you which lifts over sixty times its own weight. Easily handled by one man. Infinitely variable speed control from dead slow to 50 ft. per minute lift, 96 ft. per minute descent (1000 lb. model). Pendent or pull-cord control. Hook or trolley mounting. Roller or link chain. Automatic disc brake. 500, 1000, 2000 lb. capacities. Other models to 3 ton capacity. Your Thor factory representative or distributor will demonstrate in your own plant. Thor Power Tool Company, Aurora, Illinois. Branches in all principal cities.

Thor POWER TOOLS

CIRCLE INFORM-A-GRAM KEY NO. 26

Simple...Positive...Faster...Accurate Indexing with TRIG-R-DEX

Trig-R-Dex is a completely new concept in manual indexing that simplifies and speeds straight or spiral operations.

To index—simply grasp the Trig-R-Dex handle, push down on the trigger button and move the handle until index pin engages the next hole, pull handle to stop position and you have indexed one increment. During work processing operations, the Trig-R-Dex handle always remains stationary. But, the index plate is keyed to the driver holding the work center . . . this assures the index plate, center and workpiece turn as a unit.

By selecting proper index plate, both right- and left-hand operations having from one to ten spaces can be accurately indexed. Changing from one index plate to another is extremely easy and takes but a couple minutes.

Because Trig-R-Dex is simple in design, of rugged construction, easy to operate and precision made, it will give years of accurate, trouble-free service while reducing costs and boosting your production.

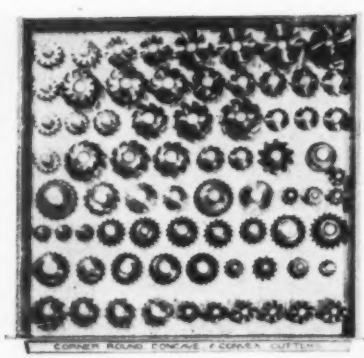
For further information, write to:

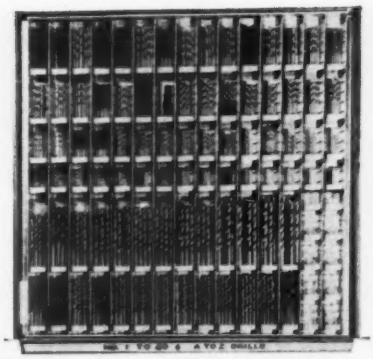
DETROIT REAMER & TOOL COMPANY

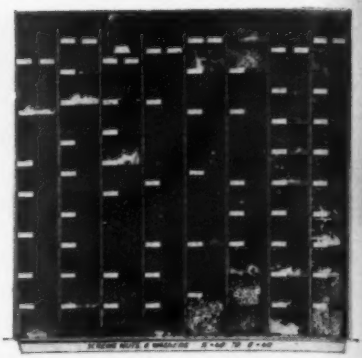
780 W. MAPLE ROAD • P.O. BOX 174 • BIRMINGHAM, MICH.

U.S. PATENT NO. 2,711,324

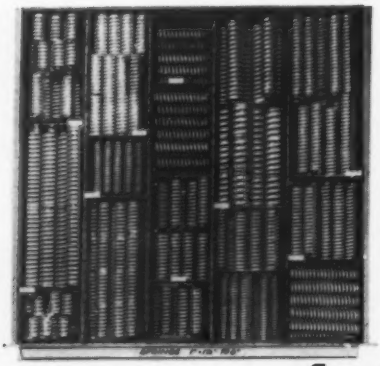
CIRCLE INFORM-A-GRAM KEY NO. 27

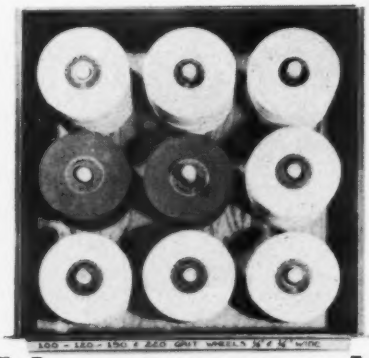


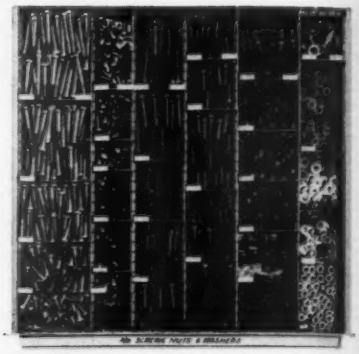




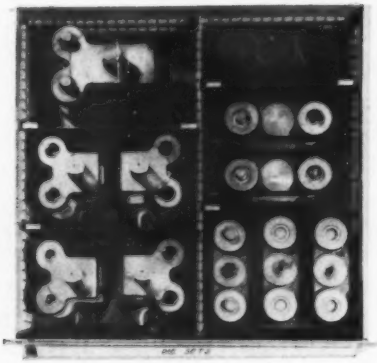
Tailor-made storage

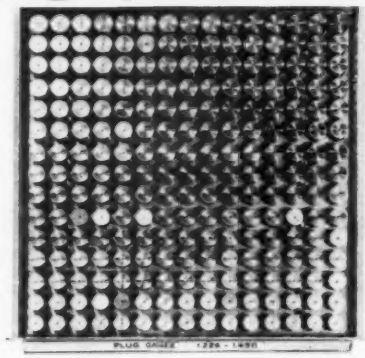


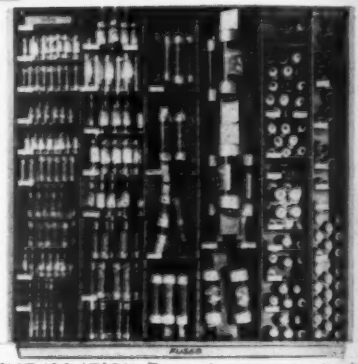




for big space savings!







VIDMAR INSTALLATION. Tremendous concentration of industrial parts in a small space. Orderly, clean, efficient.

Vidmar industrial storage cabinets are expressly planned and built to accommodate the sizes, shapes and weights typical in industrial parts, tools, gages, accessories and sub-assemblies. They are modular—can be added-to or re-arranged at any time; and they are strong... a single drawer holds up to 400 lbs. without even sagging!

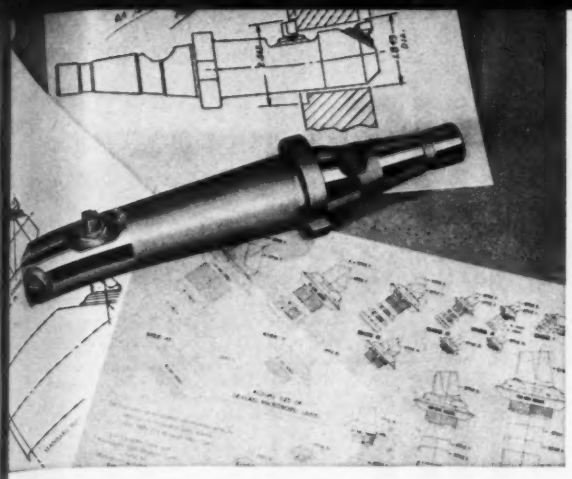
In the Vidmar system, every tool and part has its place—fully visible and accessible.. clean, safe, and readily located through large labels running the full length of drawers. Space savings average 50%.

THAT'S PART OF THE STORY. Before you revise or add to your storage facilities, or plan the storage in new construction, it will pay you to look into the many time- and money-saving advantages of the Vidmar system. Write today. **VIDMAR, INC.**, 2326 Reach Road, Williamsport, Pa.

Store more... better... in less space with

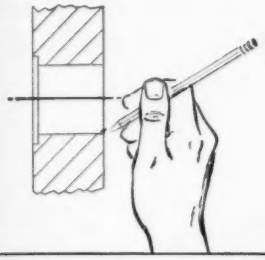
Vidmar CABINETS Division of VOLKERT STAMPINGS, INC.

CIRCLE INFORM-A-GRAM KEY NO. 28

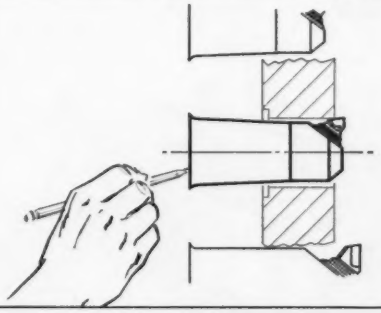


now, design your own semi-standard cluster tooling from stock Microbore components

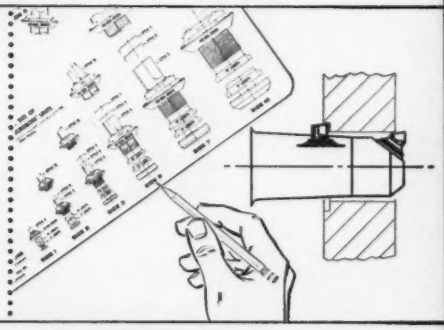
SIMPLE 5-STEP PROCEDURE



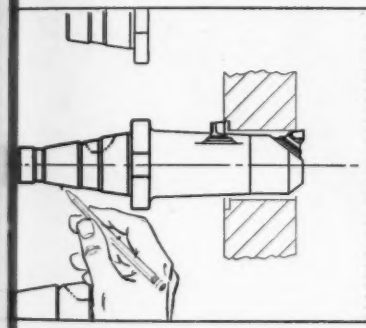
1 Make a full scale layout of bore to be produced, on tracing paper.



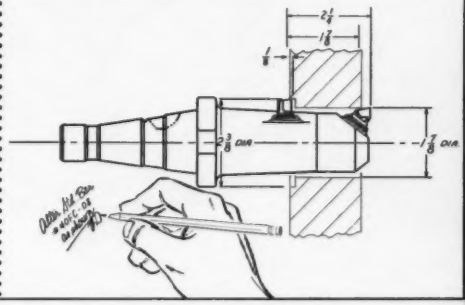
2 Place layout over standard bar nose templates. Select and trace the most suitable bar nose.



3 Select suitable Microbore Unit from template and trace in position for added tool station.



4 Trace the desired shank on boring bar, using shank template.



5 Microbore tool stations will be added to the standard Microbore Boring Bar as specified.

Simple cluster tooling designed in this manner costs little more than standard bars; substantially reduces delivery time, and is thus ideally suited for low-production applications.

NEW "TOOL DESIGNERS LAYOUT KIT" MAKES IT POSSIBLE!

Using transparent, full-size templates and a price index, it is now possible to design, pre-price and order your own semi-standard cluster tooling from stock Microbore components.

Any one of the several hundred standard Microbore Boring Bars may be converted into two- or three-tool cluster bars for such operations as boring, facing, counterboring and chamfering at one pass.

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☐ I would like further information on the Microbore "Design Kit."

☐ I would like a dealer demonstration of the design technique.

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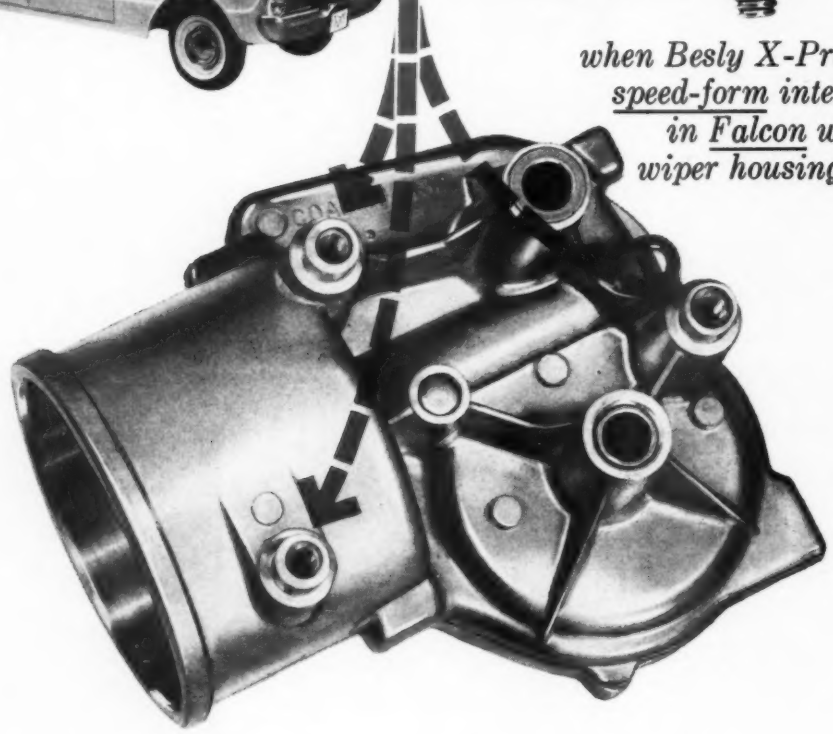
NAME OF COMPANY _____

CIRCLE INFORM-A-GRAM KEY NO. 29

FORD GAINS 500% IN TOOL LIFE

BESLY X-PRESS TAPS Speed-form internal threads in metals such as copper, brass, die castings, aluminum, lead, leaded steels and other ductile materials. They are available in standard tap sizes and various styles for through or bottoming holes. Patent No. Re. 24,572. Other patents pending.

when Besly X-Press® Taps speed-form internal threads in Falcon windshield wiper housing!



Ford Motor Company's *Falcon* will give you good forward vision in rain, snow or sleet with its powerful windshield wiper.

Besly X-Press Taps, in a Kingsbury 3-spindle machine, tap directly into three cored holes in the Falcon's aluminum die cast windshield wiper housing. Drilling operations were avoided. Production is continuous. The Besly X-Press Tap produced as high as 50,000 tapped holes before replacement – thus offering increases of approximately 500% in tool life over conventional cutting-type taps. *Speed-forming* makes stronger, burnished internal threads, without cutting. There are no chips to load the tap in bottoming holes such as these. And faster cycling speeds production!

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...FOR LONG WORKING LIFE TO ELIMINATE DOWNTIME & PRODUCTION LOSSES!

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DRILL • TAP
REAM • BORE
COUNTER-BORE
COUNTER-SINK
FACE

Tremendous economies from the use of multiple-spindle drillheads are obvious. Use *THOMSON* THRIFTMASTER Drillheads for optimum performance and profits. *Ask NOW for our new catalog.*

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STYLE "S"
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The Only Master Collet with
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CIRCLE INFORM-A-GRAM KEY NO. 32

A NEW *"COMPACT"* HITS THE MACHINE TOOL FIELD...

THE NEW HARIG 612 SURFACE GRINDER

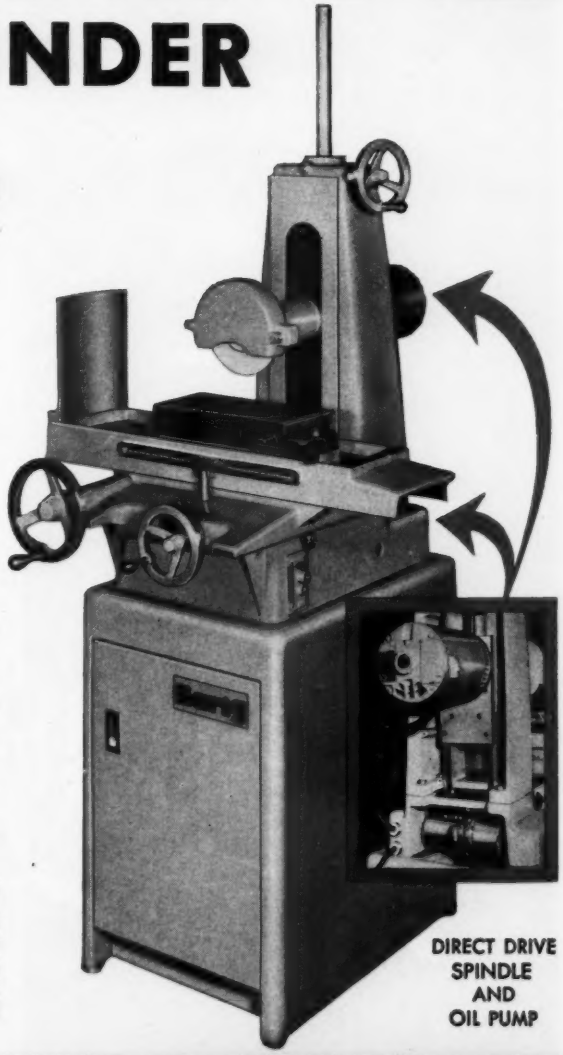
with

* **Automatic forced lubrication**
  goes into operation as soon as machine is started — triples life of the ways and preserves original accuracy.
* **Direct drive spindle**
  increases power . . . reduces vibration . . . no V-belts to replace.
* **Your choice of right or left hand longitudinal feed**

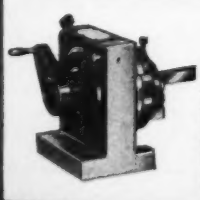
All Standard Equipment

The new 612 represents a break-thru in design and construction whereby Harig now offers industry a low-cost, precision surface grinder loaded with features usually found only on expensive models. Easy to operate . . . requires little maintenance . . . built with the precision quality you expect from Harig.

GET ALL THE FACTS . . .
Write for brochure on the Harig 612 Surface Grinder



DIRECT DRIVE SPINDLE AND OIL PUMP



HARIG'S NEW IMPROVED GRIND-ALL FIXTURE
Easily grinds irregular shaped perforators concentric with shank within ±.0001 accuracy. Also can be used as milling, boring and inspection fixture. NEW ATTACHMENTS: Radius Dresser Arm and Ball Seat Punch Adapter. (Write for new Grind-All Brochure.)

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Manufacturing Corp

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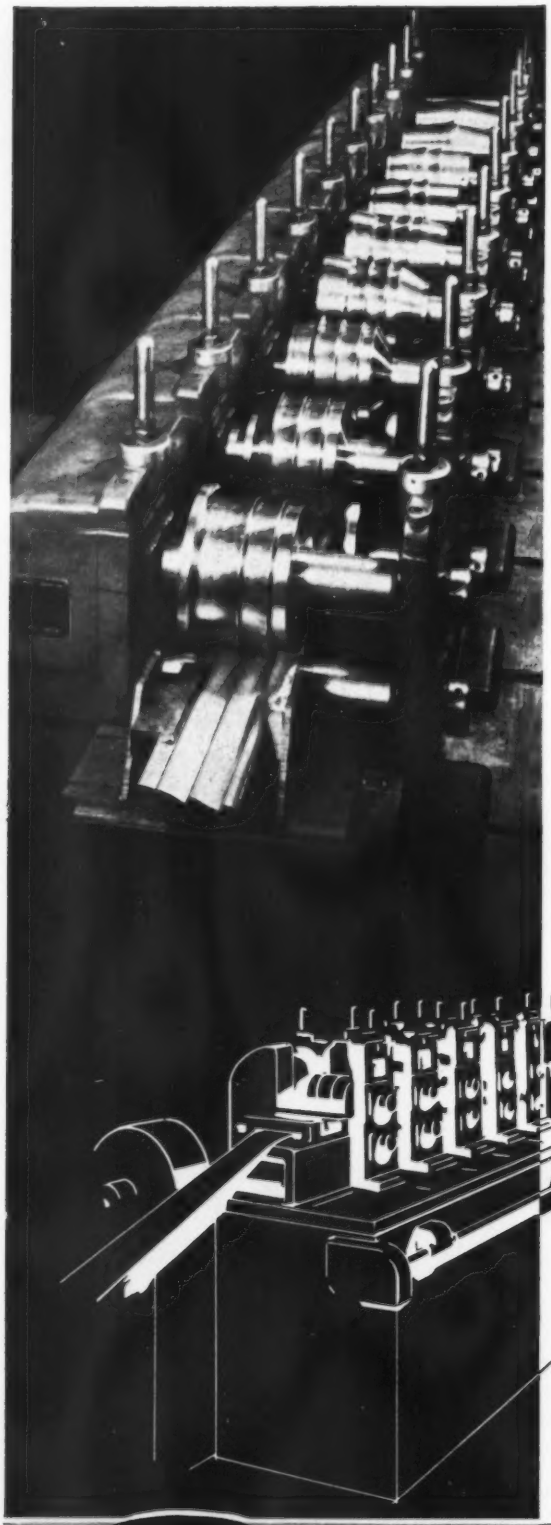

Yoder Roll-Forming Equipment mass-produces shapes accurately, economically

Yoder Roll-Forming Equipment, even with part-time operation, can effect significant savings in many metal working applications and industries. Shapes, simple or complex, can be quickly and economically produced the Yoder way from a wide variety of flat-rolled coated or uncoated stock . . . in thickness up to ¾ inch . . . in speeds up to 50,000 feet per day.

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This fully-illustrated 88-page book clearly discusses every important aspect of Yoder Roll-Forming Equipment and methods . . . it's yours for the asking!

ENGINEERING **YODER** MANUFACTURING

COLD ROLL FORMING MACHINES
PIPE AND TUBE MILLS (ferrous or non-ferrous)
ROTARY SLITTING LINES

CIRCLE INFORM-A-GRAM KEY NO. 34

MEN YOU SHOULD KNOW

Joseph Glasser has been named manager of manufacturing for Raytheon Co.'s Commercial Apparatus and Systems Division.

Beaver Tool & Engineering Corp. recently announced the appointment of **David D. Dresback** as chief engineer.

Harry G. Howell was recently appointed general manager of the Champion Division of The Steel Improvement and Forge Co.

Election of **Arthur J. Welch** as president and general manager of the Spring Division of Borg-Warner Corp. has been made known. He succeeds **Harry P. Troendly,** who now serves as chairman of the division's supervisory board. At the Warner Automotive Division, **Richard H. Wheeler** has taken over as vice-president of manufacturing, and in the engineering department of Pesco Products Division, **J. F. Murray** is now director of engineering; **Thomas D. Carpenter,** manager, future product planning; and **Louis J. Schafer,** project manager.

Newly elected president of Kollsman Instrument Corp. is **David B. Nichinson.** He succeeds **Victor E. Caronara,** who has retired. **William A. Matthews** is now serving as works manager.

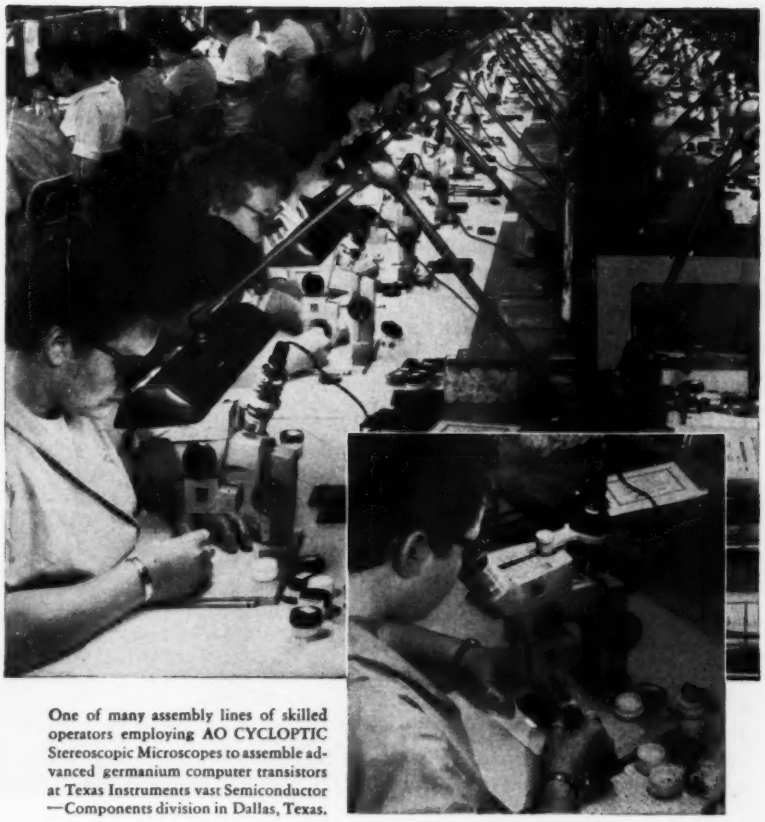
The appointments of **George W. La Salle** as vice president in charge of engineering and **Adolph A. Karrasch** as vice president in charge of manufacturing have been announced by Hercules Motors Corp.

Taking over as products manager of aluminum for the Meier Brass & Aluminum Co. is **William M. Dawe.**

Richard Henderson was recently appointed chief engineer for Arcair Co.

Newly appointed director of manufacturing of the Clearing Division of U.S. Industries, Inc., is **Henry M. Crossen.**

. . . Continued on page 38



One of many assembly lines of skilled operators employing AO CYCLOPTIC Stereoscopic Microscopes to assemble advanced germanium computer transistors at Texas Instruments vast Semiconductor —Components division in Dallas, Texas.

Here's how Texas Instruments mass produces precision transistors

with AO's CYCLOPTIC Microscope

Precision assembly of minute components for transistor production offers no problem to the skilled workers at Texas Instruments. Using the AO CYCLOPTIC Stereoscopic Microscope, material that is practically invisible to the eye assumes accurately magnified proportions...the entire assembly operation is observed in crisp, erect, three-dimensional detail.

Bright, shadowless lighting is beamed deep inside the small unit apertures with AO's exclusive Vertical Illuminator attachment. The instrument's remarkable long working distance assures the operator of complete freedom of movement and affords ample room to accommodate larger objects and assembly tools.

With the instrument body inclined at a 30° angle, the operator can work in a natural, more comfortable position.

When manufacturing small precision assemblies . . . many progressive companies such as TI, depend upon the AO CYCLOPTIC to render the unit in visual "working size" dimensions.

If you have a particular production situation that 3-D magnification would help, why not discuss it with a capable AO Sales Representative. He can recommend the AO CYCLOPTIC Stereoscopic Microscope that will certainly solve your individual problem. There is no obligation, of course.

American Optical Company

INSTRUMENT DIVISION, BUFFALO 15, NEW YORK

Dept. E-179

☐ Please have AO Sales Representative demonstrate the AO CYCLOPTIC Microscope.

☐ Please send AO CYCLOPTIC Brochure SB56.

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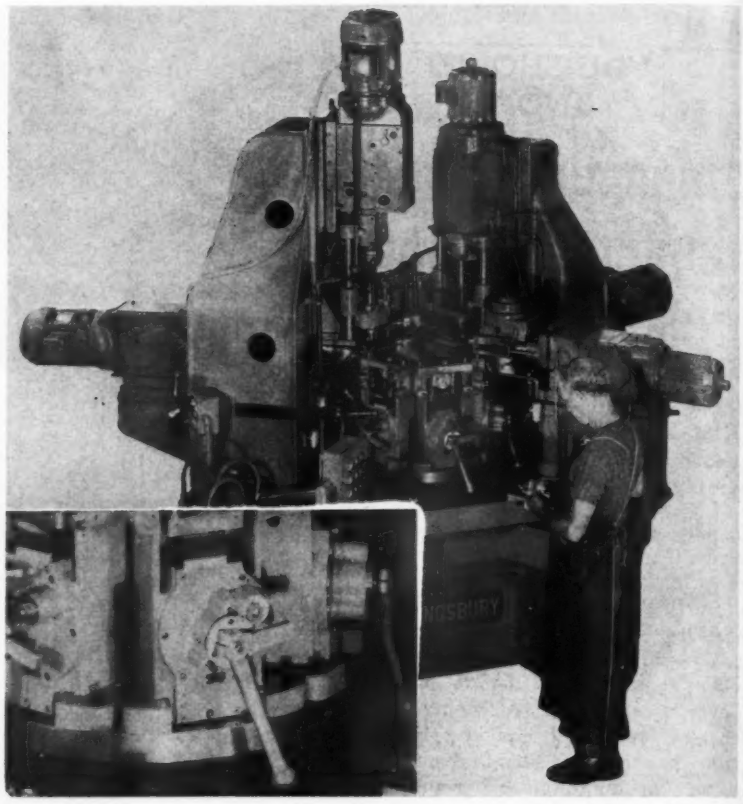
CIRCLE INFORM-A-GRAM KEY NO. 35

Multi-Unit Machine Produces Auto Parts

A multiple-head six-station "special" machines 570 die cast aluminum windshield wiper housings an hour. Built by Kingsbury Machine Tool Corp., it uses two combination tools and six plain tools to perform the boring, drilling, reaming, and tapping operations.

The work is manually clamped into the fixtures of the 26" dia index table. One vertical unit bores one hole and faces four bosses around it with a combination tool. The other vertical unit reams the hole.

The first horizontal unit has a combination tool for eight drilling, countersinking, chamfering, and undercutting operations. A second unit drills one hole, and a third taps three holes. The last horizontal unit operates two 5" slitting saws, using a milling head with a vertically adjustable arbor.



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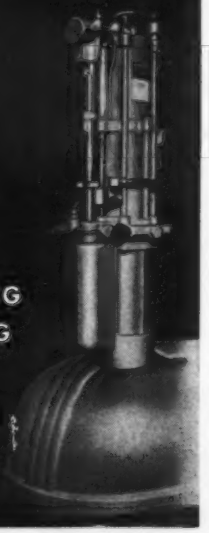
★ SPOT FACING
★ BOX TOOLING
★ SKIP DRILLING
★ COUNTER-BORING
★ HOLLOW MILLING



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THE GENERAL FIRE EXTINGUISHER CORP.
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TAP & DEBURR IN ONE OPERATION

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1 set-up—
1 operation—
instead of 2!

Burr-Bit by Vernon Devices is made of the finest quality high speed tool steel. It fits all 2, 3 and 4 flute taps, and can be used on almost any material.

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CIRCLE INFORM-A-GRAM KEY NO. 38

. . . Men from page 35

Carl F. Schaefer now serves as engineering manager, and **Ernest J. Greenwood** operations manager, of United Aircraft Corp.'s Norden Division. Other promotions include **Frank S. Preston,** chief engineer; **Edward R. Harris,** assistant chief engineer; **Leo Botwin,** chief engineering operations; **Malcolm V. Lane,** administrative engineer; and **Robert D. Rinehart,** chief component engineering.

C. E. Hitch is now serving as manufacturing manager at F. Jos. Lamb Co.

John E. Brennan, vice president and group executive, Chrysler Corp., Stamping and Chassis Parts Group, has been appointed director of the corporate manufacturing staff and services. He succeeds **L. I. Woolson,** corporate vice president, who now serves as general manager of the company's newly-formed Service Parts and Accessory Division. Other appointments include **Harry R. Bentley,** plant manager of the Trenton (Mich.) engine plant, and **John B. Kendall,** manager of the Conant Stamping plant.

The appointment of **Henry J. Christ, Jr.** as vice president of operations of the Gabriel Division of the Gabriel Co. has been announced.

R-O Mfg. Co. has announced that **William A. Johnson** has been elected president and **Elwood Hemlin,** vice president of the company.

Thomas H. Jeffers has been named director of facilities and tooling by Robertshaw-Fulton Controls Co.

Winsmith, Inc., has named **John M. Melisz** chief engineer.

Newly appointed chief engineer of White Truck Division, The White Motor Co., is **E. R. Sternberg.**

Planet Corp. has announced that **Robert E. Place** was recently named chief estimator; **Joseph Brown,** chief engineer; and **Daniel Smith,** production manager.

New factory manager at Bosworth Steel Treating Corp. is **Robert F. Lutz.**

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Worm accuracy—¼ sec.
Repetition of settings—½ sec.
Total error in any position—2 sec.
2 sec. = 0.00005" (½ tenth) on 10" dia.

Now...with this new No. 2 Moore Ultra-Precise 11-inch 2 sec. Rotary Table—you can provide the closest precision angular spacing needed today. It reads to 1 sec. and has an overall performance accuracy of ± 2 sec. throughout the entire 360°. It is being widely used in angular locations for guidance systems. A nondisengageable, thread-ground worm, combined with the accurately spaced teeth of its mating gear, makes this extreme precision possible. Loss of accuracy, due to repeated throwing in and out of the worm, is eliminated.

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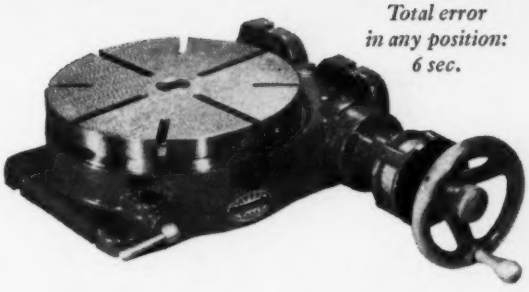

Total error in any position: 6 sec.

GUARANTEED POSITIONING ACCURACY FOR SHOP USE

All points in 90° increments, from zero, ± 1½ sec.
All points in 18° increments, from zero, ± 2 sec.
All points in 2° increments, from zero, ± 4 sec.
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Total error in any position—6 sec.
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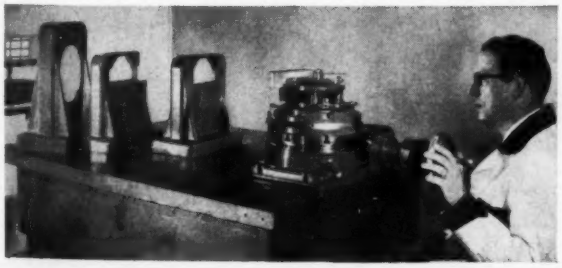

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CIRCLE INFORM-A-GRAM KEY NO. 39

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Photo: Courtesy Ex-Cell-O Corporation, Detroit, Mich.

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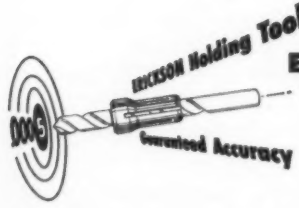

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CIRCLE INFORM-A-GRAM KEY NO. 40

Guest Editorial

And The Greatest of These Is Quality

SEVENTY-FIVE YEARS AGO a group of German cabinetmakers who had come to this country to seek their fortune were unable to buy proper tools to continue their fine craftsmanship. Our steel was poor, hence, so were the tools. In disgust the artisans called America "Humbugland."

Though our steel is now as fine as any produced anywhere in the world, there is still room for criticism of American products. Indeed, there is reason to suspect that many Americans have completely lost pride in workmanship; that they are more concerned with their pay checks, vacations, job security, et cetera, than they are with turning out a fine product.

Even expensive automobiles sometimes come out with not-quite-perfect upholstery, missing screws. A less expensive car may have a trunk lid put on so sloppily that when it is raised it rubs on one side and misses the other side by a quarter of an inch.

We believe that Joseph E. Adams, White Motor Co. official, hit the nail on the head when he said [at the recent SAE National Production Meeting] that quality in the things we make is an important answer to the threat of foreign competition, and that Peter B. Greenough, Plain Dealer general business editor, summed it up when he wrote ". . . our foreign economic policy begins right in the factory. The enemy is shoddy goods, not a nebulous competitor in some far-off place."

Perhaps the things we manufacture are too complicated; a washing machine used to be a comparatively simple thing, today it isn't. Consider the difference between the equipment needed to adjust seats in an American automobile, and the small lug which accomplished the same purpose in a Volkswagen.

To be sure, the complexity of the things we manufacture insures service calls, and perhaps this helps keep the economy running, but every once in a while one thinks nostalgically of the days when you could hit the motor of a balky flivver with a hammer—and presto, it would run!

We can't beat foreign imports by crying that it's impossible to compete because they have cheap labor and we don't. We must beat them at their own game, by producing outstanding goods—with no screws missing. Greater efficiency, more automation and quality control—and the greatest of these is quality!

The CLEVELAND PLAIN DEALER, a major metropolitan daily newspaper, carried on its editorial page for March 25, this Quality Control message of vital import to every Q-C worker and department within range of Tooling & Production's industry-wide national circulation.

Although the PLAIN DEALER editorial was addressed to consumers, across the board, its pertinency to your specialized Q-C responsibilities impels us to reproduce it here as a guest editorial. Its message is one which we must all take to heart. It is the be-all and end-all of Quality Control.

E.W.P.
Editor

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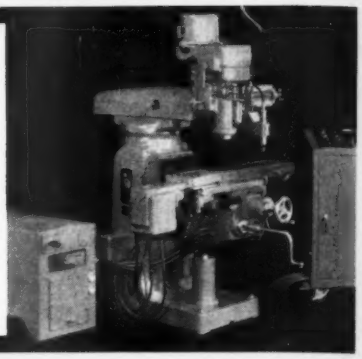
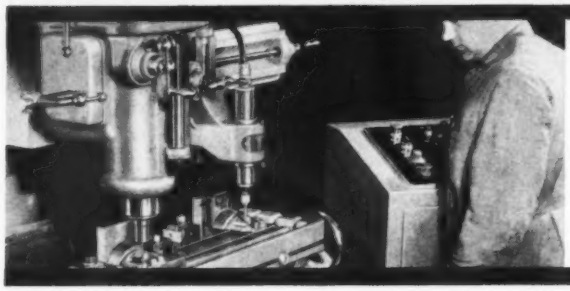
ON A GORTON 180° *Fully Automatic* AUTO-TRACE DUPLICATOR





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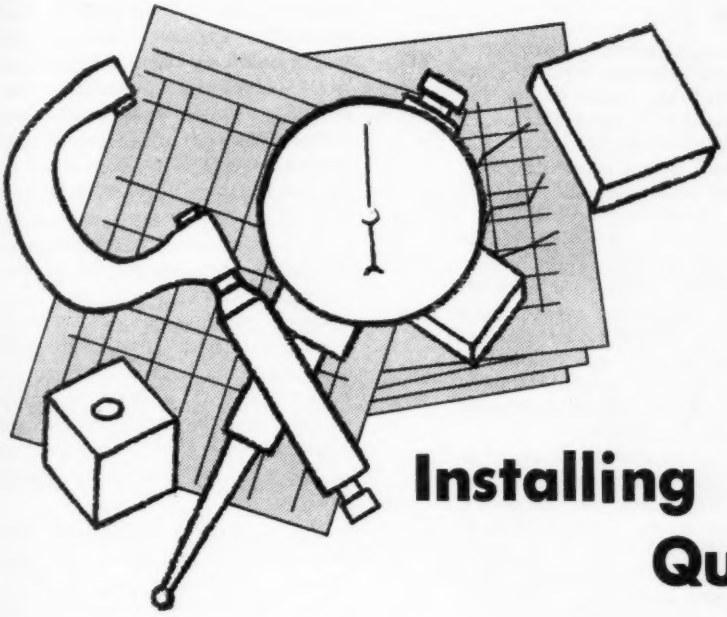


Installing Quality Control

by Ralph B. Nottingham

Mr. Nottingham is Director of Quality Control at the North Electric Company, Galion, Ohio. A popular contributor to Tooling & Production in past years, some readers may remember his "How Do We Measure Machine Capabilities?", "Peg-Board Q-C," and "Do You Know Your Machine Capabilities?"

For 13 years Tooling & Production has acknowledged and promoted Quality Control as an important manufacturing function by featuring Q-C especially in the issue nearest the date of the Annual Meeting of the American Society for Quality Control. This year's meeting is May 24-26 in San Francisco, and this issue's Q-C messages, collected and edited for all of Tooling & Production's readers, are contained in three articles: The Guest Editorial on page 41, "Installing Q-C" beginning on this page, and "A Workable Quality Bonus Plan" on page 49. — The Editors.

IF YOU ARE GIVEN the opportunity of installing Quality Control in a company which has none, our best advice is, don't do it—unless, you are thoroughly convinced that the management of the company really wants Quality Control, and wants it as a fundamental tool of modern management, not simply as a requirement of a government contract.

Many able Quality Control engineers have failed in attempts to install successful systems because they did not realize that the company was unwilling to give more than lip service to the Quality Control concept.

The first impression you form on the corporation may well be a lasting one—speak softly, move slowly, and develop a reputation for

Q-C Philosophy, Reviewed . . .

MODERN CORPORATIONS utilizing scientific management operate under a system of checks and balances. While the direct manufacturing line management has responsibility for production, a number of staff positions have been created to assure that special facets of the operations do not suffer.

Most corporations have a controller, whose responsibility it is to see that a reasonable budget is established and adhered to, so that finances will be available to meet bills.

Personnel or Employee Relations Directors have been established, not to usurp the manufacturing manager's right to hire and fire, but to assure that consistent policies are pursued.

In an analogous manner, modern corporation management feels that it is essential to have a staff Quality Control organization. It is almost obvious that the only way to be sure that a job will get done is to give one man specific responsibility for its completion. That which is just left to everyone's business may easily become nobody's business.

Just as the Controller guards the financial position of a company, and the Personnel Director its labor relations, so does the Director of Quality Control guard the company's quality reputation. He endeavors to assure that attention is given to factors affecting quality in all phases of the company's operations. He is a sort of a corporate conscience leaning over the shoulder of the organization and saying, "All right, do it quickly, do it economically, but DO IT RIGHT!"

The Quality Control organization does not produce directly anymore than the Controller produces profits, but the functions of Quality Control are fundamentally economic. Shewhart wisely entitled his classic work, which was the foundation of Quality Control, "Economic Control of Manufactured Product." As we shall see, the Quality Control organization can be highly productive.

Quality is always a cost; either excessively low or high quality is uneconomical. Either one can quickly put a company out of business. Clearly, economic control is that which results in complete customer satisfaction at minimum cost. What sort of organization is required to produce this result?

First, the capabilities and the organizational position of the group charged with this responsibility must be appropriate. By the organizational status given to Quality Control, the management clearly tells the world the importance it places on quality.

If Quality is as important as direct cost, those charged with Quality Control must have the same status as those charged with direct cost control. Further, since the factors affecting quality may be highly technical, the Quality Control Organization must have technical competence in general engineering as well as Quality Control methods.

Quality Control organizations originally devoted themselves almost exclusively to control of the manufacturing process. This is logical as a beginning point when such an organization is established in a going operation. However, it soon becomes clear that not all quality problems arise from material and workmanship. They also arise from application, design, and maintenance.

Much attention has been focused on Reliability of late. Reliability, or the lack thereof, has become particularly conspicuous in the case of missiles, where human ingenuity and intervention cannot compensate for product weakness.

Reliability groups established in missile organizations deal to a great extent with the effect of design on reliability, and are, therefore, sometimes engineering staff functions. If we have accepted the concept of "Total Quality Control," reliability engineering is a logical segment of such a function. If, however, our Quality Control group is devoted only to manufacturing problems, a separate but closely related engineering reliability group may be appropriate.

listening and getting results. Any successful Quality Control program must be individually tailored to the company. A plan taken from a text—or an exact copy of a plan which worked well in another company will not be enough. A few months will be required to size up the company, become familiar with its policies, products, problems and people: those you will be dealing with, and those you may employ in your program. These early months when the program is being crystallized are not to be spent in idleness—tangible results can be achieved in the areas which are least sensitive and which can be reasonably standardized.

The instrument and/or gage laboratory, gage inventory, and calibration procedures can be established, and the receiving inspection function started or reorganized.

During this period the Quality Control manual will be prepared, for use both as a procedure guide, and as a training manual.

Forms must be developed, procedures outlined, including basic statistical Quality Control methods such as:

- Sampling plans.
- Control charts for variables and attributes.
- Lot plot, or other variables plans.
- Scrap and rework reporting procedures.

Since Quality Control is fundamentally economic in nature, scrap and rework analysis will indicate those areas where there is the greatest gold in the mine. It is quite possible that the company has no method of isolating scrap and rework costs, and it is almost certain that there are no reliable scrap and rework records. Any company which had such records would have long since seen the necessity for Quality Control.

In some departments these costs may be difficult to determine, but they will always yield to input output analysis. The difference between parts or material going to a department and those flowing out in the form of finished goods may be assumed to be scrap until it is proven otherwise.

Once cost figures are obtained, Quality Control effort should be concentrated in the department with highest Quality costs. If substantial savings are achieved here, and if manufacturing personnel are given full credit, other department heads will begin to request Quality Control assistance without having services thrust upon them.

One organizational problem will be the assignment of responsibility for testing. While there may be instances in which it is reasonable to include testing as part of the Quality Control function, this is generally not good practice. By so doing, manufacturing may be encouraged to pass the responsibility for quality on to the Quality Control department, with disastrous results in terms of quality economics.

First Year's Goal

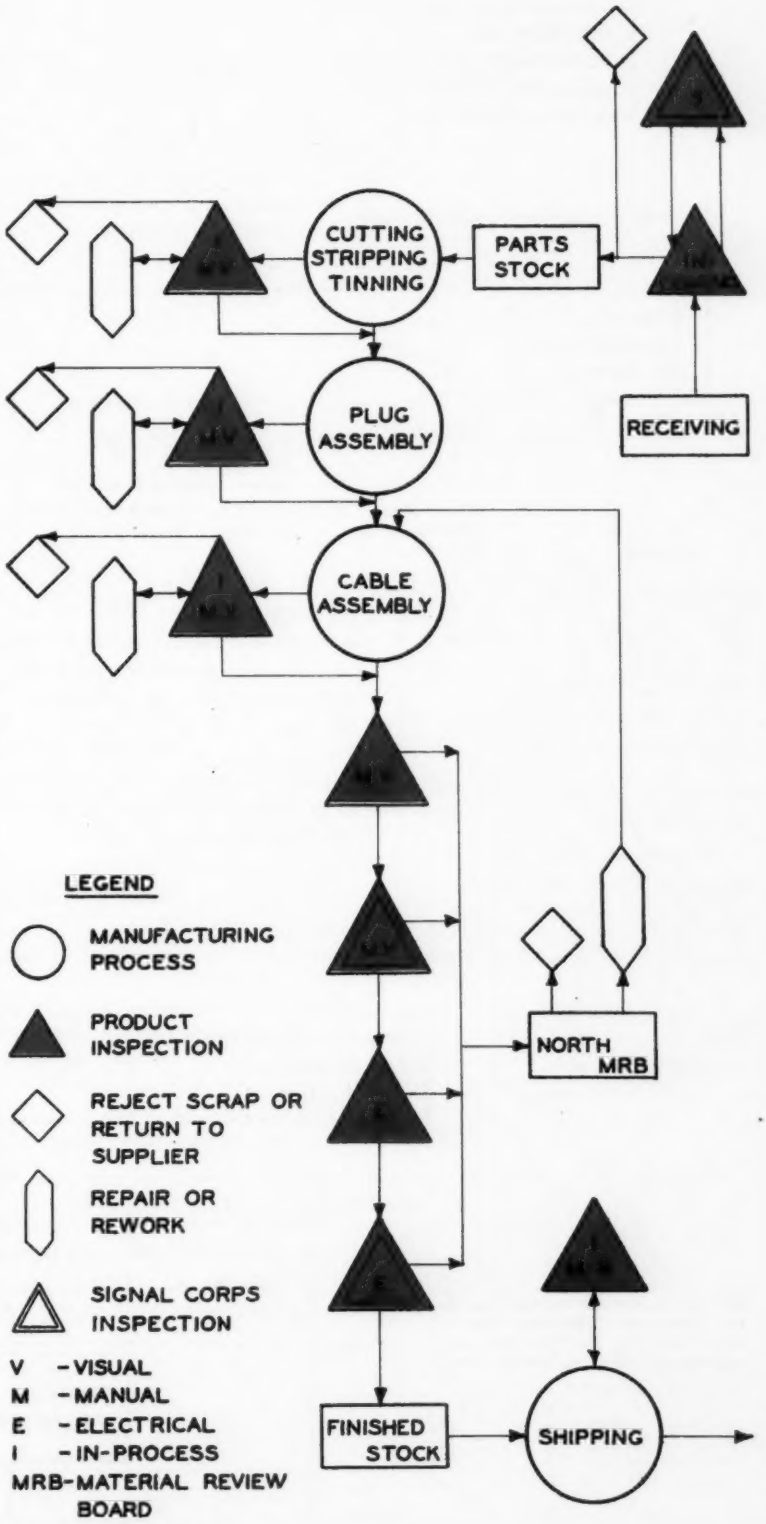
Previously, we mentioned the use of the Quality Control Manual as a training manual. More of your efforts in the first year must be devoted to training than to anything else. We feel strongly that most effective training can be accomplished by requiring that all people receive training only from their immediate superior.

In other words, you train those who will report to you, and require that they pass this training on to all those who report to them. Nothing seems to motivate a man to learn quite like the knowledge that he will be called upon to teach the material which he is learning.

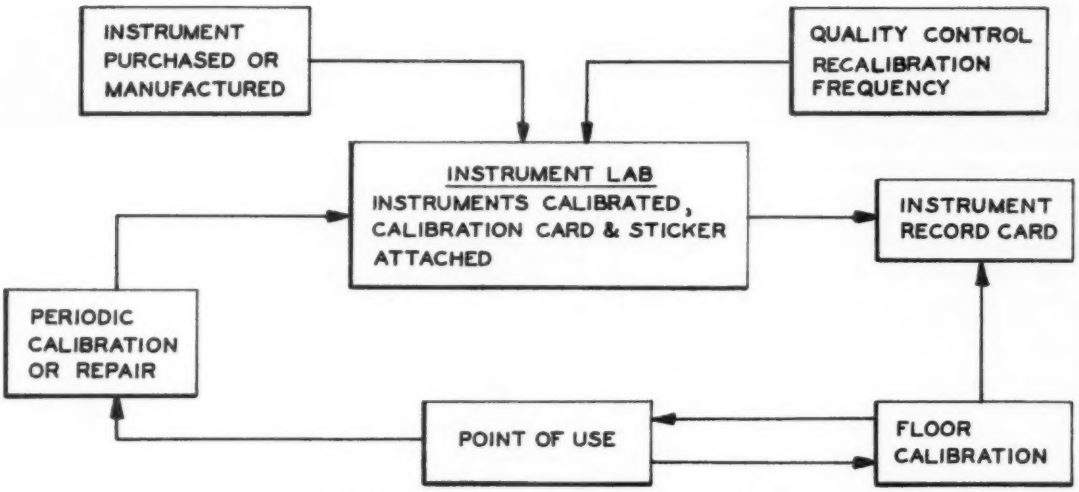
Training for existing inspection personnel will be nearly a brainwashing procedure, designed to break them away from the traffic cop concept of the inspector whose sole aim is to reject material, to the constructive concept of Quality Control and defect prevention.

Once we have instilled the philosophy that the responsibility for quality is that of the operator and not that of Quality Control, it is important that we put into effect a system which will provide prompt economical indication of quality by operators.

We have built such a system around patrol inspection, and an IBM Mark Sense card system. These cards are pre-punched with



Flow chart illustrates typical military equipment inspection procedures established by North Electric Co. Due to the critical nature of this material and the small quantity of individual items, all equipment of this type is given 100% final electrical and mechanical inspection.



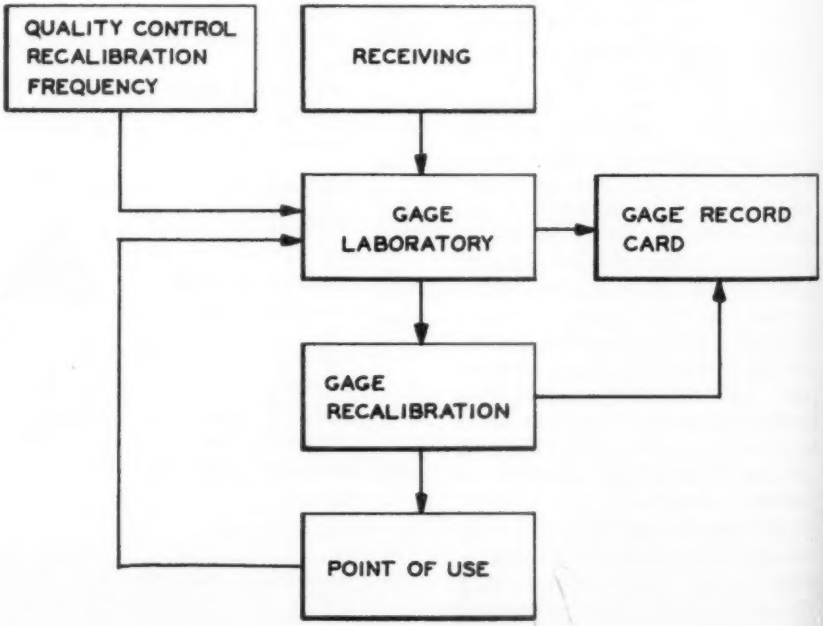
North Electric Co.'s Manual on their Quality Control and Inspection Plan carries this quick reference to inspection.

the department number and the inspector number. Process inspection information is recorded on the card, and the number inspected, number effective, and defect code are Mark Sense coded. In the tabulating department, the marked information is automatically punched into cards with no key punching costs.

A weekly tabulation is then made by department and by operator, and reported to Quality Control for analysis and distribution. None of the information written on the cards is routinely key punched. However, when the percent defective is calculated for tabulation, it is tested against standard values which are a function of the number of pieces inspected. If the percent exceeds the critical value, the card can be key punched to provide analysis by part number and nature of defect.

This application of the principle of management by exception has greatly reduced the cost of these analyses. The tabulated values are used to post individual operator quality charts in each manufacturing department to keep both the supervisor and operator aware of the quality status. Simply posting these charts has resulted in reduction of percent defective by factors of five to ten; a tremendous cost saving produced at negligible cost.

Once the manufacturing Quality Control process has been well started in the right direction, the next logical step is the establishment of Quality Control laboratory



All test equipment is delivered to the Instrument Calibration Laboratory. The flow sheet for the calibration operation is shown here.

facilities. Quality Control always is in an ideal judicial position. Since it does not design, manufacture or sell the product it can take a dispassionate customer's eye view of finished product quality. Product quality assurance is obtained through a number of evaluations by the Quality Control laboratory, such as:

1. Bread board models or prototypes of new designs are evaluated against the specification which the design was intended to meet.

2. Pilot run samples are again evaluated to assure that production methods and tooling have maintained the design's capability.

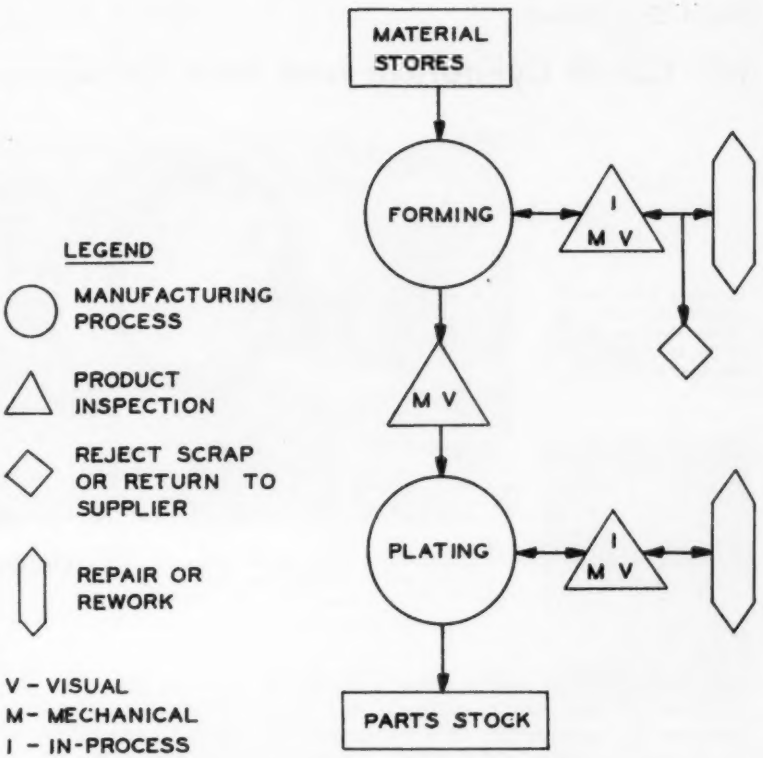
3. Periodically, samples are drawn from production runs and re-evaluated.

Only by process such as this can we assure that quality is designed into the product, and that the designed quality and reliability are maintained for the life of the design.

The Quality Control laboratory, of course, has facilities for environmental and life testing. These facilities are designed to meet 95% of our testing requirements. When tests are required which exceed the capability of our facilities, outside testing laboratories are employed.

When an evaluation program has been at work for some time, it will become apparent to the design engineer that he might well employ Quality Control services to anticipate weaknesses in his design, rather than to discover them after the design is complete.

This leads naturally into a total Quality Control program, designed to economically control the quality of manufactured product through the design, manufacturing, and use phases. Only by such a program can you assure maximum customer satisfaction at minimum cost.



All gage calibration records are maintained in North Electric's Gage Laboratory. The primary standards for dimensional measurements are a set of Class A gage blocks certified by the manufacturer.

Extra copies of this article are available while supply lasts. Write Tooling & Production Magazine, 1975 Lee Rd., Cleveland 18.

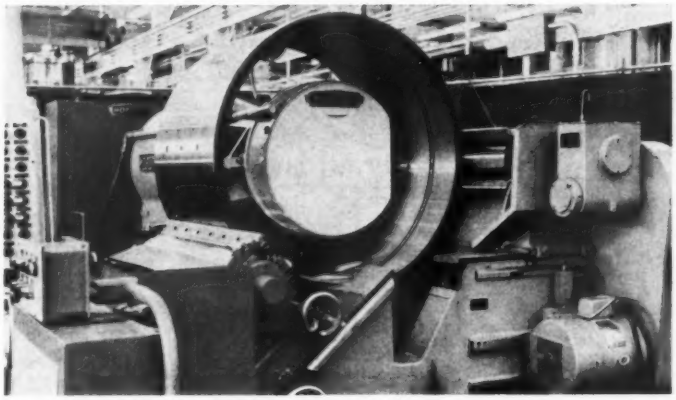
EFFICIENCY OF INSPECTION METHODS

Method in Order of Efficiency	REQUIREMENTS FOR APPLICATION		
	VARIABLES MEASUREMENT CAN BE MADE	SEQUENCE OF MANUFACTURE PRESERVED	HOMOGENEITY OF LOT
Control Chart (x & R)	Yes	Yes	Yes
Lot Plot	Yes	No	Yes
P Chart	No	Yes	Yes
Attribute Sample	No	No	Yes
Sorting	No	No	No

These are the procedures followed at North Electric when fabrication involves parts from the machine shop and press room.

From the Cover:

60" OD-ID Cylindrical and Face Grinder—Tackles Large Bearing Rings



Bearing race (work piece) resting on rollers, showing details of the drive roller and the drive to the roller.

SKF INDUSTRIES had a "big" grinding problem, and tri-mutual development cooperation—involving Norton Co., SKF, and Machinery Associates, Inc. of Philadelphia—led to its solution with the development of a 60" OD-ID cylindrical and face grinder.

Primarily for grinding unusually large roll neck bearing rings SKF makes, the big Norton machine will take work to 62" OD and 50" wide. Continuous support across the length of the work is their key to precision work holding and thus, precision grinding.

The machine provides for the important advantage of grinding the critical concentricity between the OD and bore of the large bearing races in a single machine. In addition to the benefits resulting from achieving concentricity more easily and quickly on a single machine, it also permits grinding the bearing race ends with a cup-type wheel.

Bearing races are centerless ground, with the work resting on a cross-slide on two spaced rolls. One is a driven roll for rotating the workpiece; the other, a support roll. Both are interchangeable and can be re-ground, when necessary, in the drive roll position in the machine. Adjustments for varying workpiece heights are made by changing roll position, which is aided by scales conveniently mounted adjacent to each roll.

The ID grinding occurs at the point where the OD is driven by the drive roll. This is particularly efficient; the bore is actually generated by the OD, thus assuring concentricity. When OD grinding, the work center is set above the wheel center, which is normal with centerless grinding.

The workpiece is held in a swivel cross-slide, mounted on a longitudinally traversing carriage. OD, ID, and race ends are all ground with the part in the same relative position in the cross-slide. Because of the swivel feature of the cross-slide, tapers can be ground in the bore.

Longitudinal movement of the carriage carries the work across the face of the grinding wheel for grinding both the ID and OD, and the movement of the cross-slide carries it into the grinding wheel for stock removal.

For grinding the race end, the carriage and cross-slide remain stationary. The work is moved into the cup wheel by a back-up and a feed roll, which serve additionally to retain the work in the desired horizontal position during OD and bore grinds.

The position of the grinding wheel head can be changed (with the aid of a power mechanism) for different OD's and ID's, but it is stationary throughout either grind.

Other features that simplify operation of the big new grinder include rapid power positioning and withdrawal of the cross-slide, and automatic picker feed of the slide at carriage reversals. The latter eliminates the need for the operator to pay constant attention to feeding. Carriage reversals will occur automatically at desired points, but the carriage will reverse anywhere within these points when a toggle switch is touched.

An easily set dog-wheel on the front of the machine provides automatic control of carriage traverse for both grinding and truing. Swinging one set of dogs out of the way makes the change.

The cross-slide feed handwheel, mounted on the carriage, travels with it to provide the operator with a convenient means of control as he views contact of wheel and work at either end of the bearing race. The handwheel has the Norton "click-count" indexing mechanism, for making extremely fine-increment feed settings "by ear." end

Does your company have a field quality problem which better attitude and workmanship could cure? If so, try this plan for achieving better quality. Assembly Products put it into operation eight months ago, and found that "money talks" in keeping an employee aware of his quality control function. The firm is principal producer of a precision-built, highly versatile control instrument — the meter-relay.

A Workable Quality Bonus Plan

by Frank L. Ross

Mr. Ross is quality control manager for the Controls Division of Assembly Products, Inc., Chesterland, Ohio.

TAP ANY PRODUCTION line worker on the shoulder and ask what can be done to raise your quality, and cut down on customer returns. Then prepare yourself for a most amazing flow of ideas. They won't all be usable ideas, but it will demonstrate that almost everyone in your operation is thinking about quality.

Then why don't your quality suggestion boxes burst with these ideas? The reasons are many. Some people lack the ability to express their ideas. Some are reluctant to participate because they may be pointing out some unfavorable situation in their area that will reflect negatively on their supervisor. Still others figure the judging is unfair because they see their ideas go into effect without their winning an award. But perhaps the most tangible reason is the lack of incentive to participate.

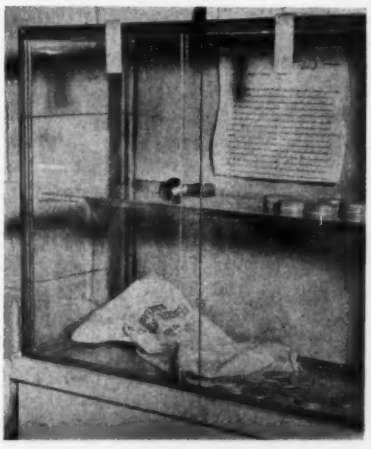
A quality bonus in which everyone participates will not only give an existing suggestion scheme a "shot in the arm," but could also effect drastic changes in employee attitude toward practicing quality instead of just thinking about it.

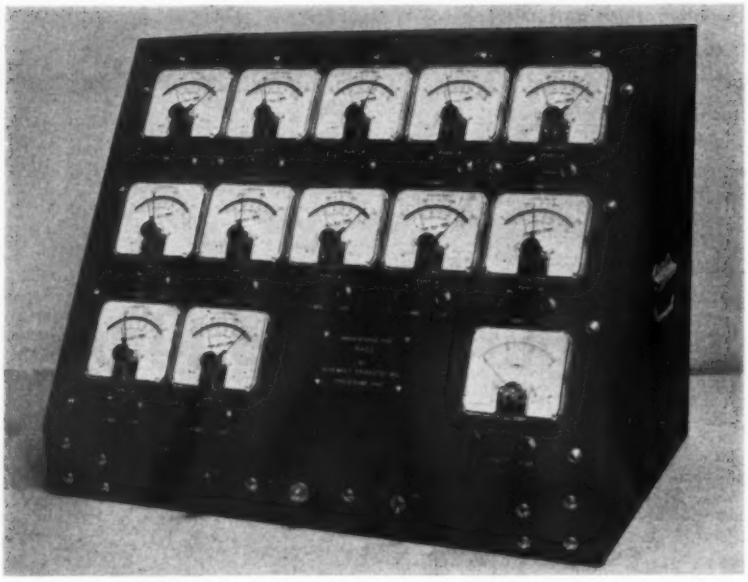
But, alas, top management usually approaches this sort of scheme with mixed emotions. Rest assured, this is no plan to be undertaken by the faint-hearted, for it's the employee's bonus check that responds to changes in the company's quality level. It takes a lot of intestinal fortitude to reveal some of the figures that must be known in order for the plan to be understood and trusted.

Basically, the plan works like this. The preceding year's gross business volume is divided by 12 to give a monthly dollar output figure. Then the preceding year's credit issued to customers for material returns is also reduced to a monthly dollar average. Suppose these figures come out to $500,000 and $10,000, respectively. This establishes a Field Reference of 2% rejects to shoot at for a given month. Now you divide your current month's returns by the month's gross volume, and find that returns amounted to only 1% of volume. If you did $500,000 worth of business that month, you could add $5,000 to the employee bonus pool. If the return percentage is greater than the established Field Reference figure, the dollar amount is subtracted from the pool.

If the first month ends well, and it's announced that customer returns were below average and X dollars are added to the bonus, hats will fly. If, however, (and this is more likely) the first month ends with customer returns above aver-

This stack of silver dollars, on display in the cafeteria, reminds each API employee that he can profit from putting his quality improvement ideas on paper.





Each API employee who handles this multi-point temperature monitor knows that his share in the quality bonus pool is directly proportional to his efforts to improve the product. This instrument is made for the National Aeronautics & Space Administration's Lewis Research Center in Cleveland.

age and it's announced that X dollars are being withdrawn from the bonus pool, tempers may flare. Everyone will suddenly be vitally interested in "why so many customer returns?" Very deft explanations may be in order to prove that all customer returns are caused; they don't just happen.

A sales order mistake, an engineering error, faulty workmanship, a component failure—any of these might be responsible for the return. Rarely is it something that can't be prevented from recurring. Since each employee stands to gain or lose through the plan, each will soon become aware of his part in preventing customer returns.

The matter of when to adjust the average return reference percentage must eventually come up for review. This will depend on how quickly, and how much, customer returns drop. Most companies should prepare to recalculate this figure once a year. It should also be arranged that the quality bonus is paid quarterly or semi-annually. Whether it's distributed per capita, or in proportion to the employee base rate times hours worked is another matter to decide.

If the quality bonus is kept separate from existing profit-sharing plans, an additional gain goes to employees. As customer returns drop, profits rise, increasing the size of that bonus check as well as the quality bonus pool.

Our plan at Assembly Products is now in its eighth month. It showed a loss after the first month, but has registered gains for each month since, adding to the existing hourly employee bonus, to the "key man group" bonus, and to the company officers' bonus.

Our quality suggestion campaign now gets increased attention, and suggestions have been noticeably better ones. We're happy with results of the plan so far, but none of us will forget what can happen to our bonus checks if we rest on our oars and let some "goof" get out the door. Would you?

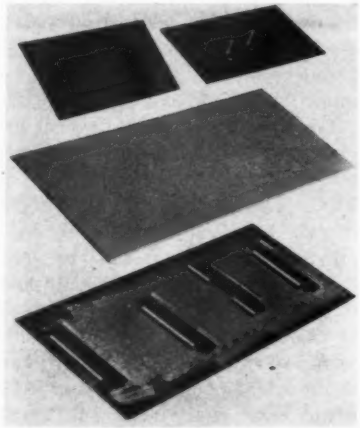
Extra copies of this article are available while supply lasts. Write Tooling & Production Magazine, 1975 Lee Rd., Cleveland 18.

Welds Coated Metals Fast And Easily

A new "spike" welder, capable of 500 welds/min, plus blemish-free welding of coated metals and 1/8″ aluminum pieces, promises to solve difficult welding problems.

The new welder produces 100,000 amp pulses of approximately one millisecond duration, yet requires no additional service lines. It's by Weldex Div. of The Metal/Craft Co., and has four months' of production tests under its belt.

The machine has been used to



weld vinyl-clad and lacquer-coated metals (illust.). Studs, clips, and brackets were welded on steel without damage or discoloration to the coating.

Similar successful applications include the welding of chrome and copper plated metals, dissimilar and nonferrous metals. The Weldex unit will also perform qualification welds in joining pieces of 1/8″ aluminum stock. Normally, this application requires 200 KVA welders. In many areas this amount of power is not available; where it is, a transformer must be adjacent to the welder.

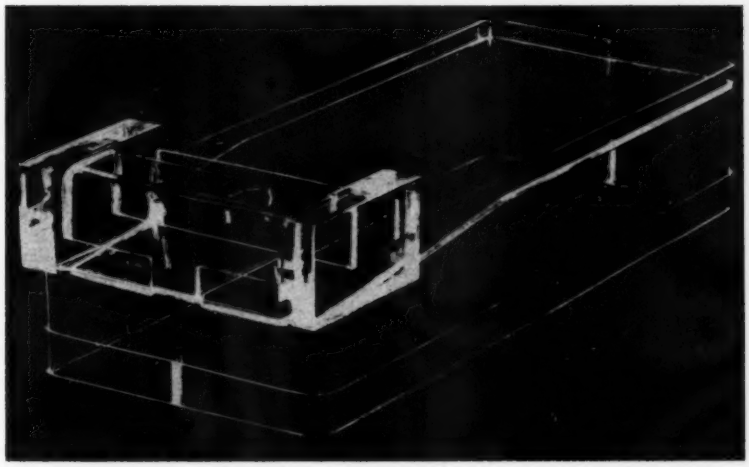


Fig. 1. Base shell of a boring machine model made of cemented plexiglass. By the use of polarized light studies it was brought to optimum size, shape, and weight. The actual machine tool base, in turn, enjoyed optimum size, shape, and weight by taking its proportion from the model.

Try Your Ideas With Plastic Models

As the embryo of a machine develops, the designer is often faced with demands for greater accuracy and speed than its predecessors had, in less space. The demands for miniaturization and compactness, alone, are structural roadblocks that stop over-design based on traditional methods. Enter untried design concepts!

Welded fabrication of machine tool bases is not new. Neither is the necessity for a means of structural analysis to handle design problems. But, the combination of welded base design, backed up by structural design proofs furnished with the aid of clear plastic scale models, is new and valuable; so much so, in fact, that a paper on it won for A. J. Purcell and T. P. Theodores of The Heald Machine Co., Worcester, Mass., one of the awards of the James F. Lincoln Arc Welding Foundation program.

This article is excerpted from their paper. The method provides a way of doing preliminary work and offers assurance that yet untried design assumptions are valid.

Fig. 2. Stress concentrations appear in weld fillets and corners when subjected to polarized light.

THE PHYSICAL CHARACTERISTICS of transparent scale models parallel those of a welded steel machine base. By making photo-elastic studies of a model, excessive ribbing can be eliminated. On the other hand, areas that need structural attention can be determined. This costs considerably less than discovering errors in the final weldment, and finalized drawings can be made by reference to the scale model.

The base shell of a boring machine, shown in Figure 1, was made by the use of polarized light studies. Considerable reduction in size, weight, and cost were realized that helped to accomplish miniaturization, compactness, and simplicity.

Construction Techniques

During the drying and hardening of "cement" used in building up plastic models, "pulling" takes place which leaves residual strains similar to those of a weld. So, since the characteristics of steel weldments are similar to those of formed and joined plexiglass (or other transparent materials), a

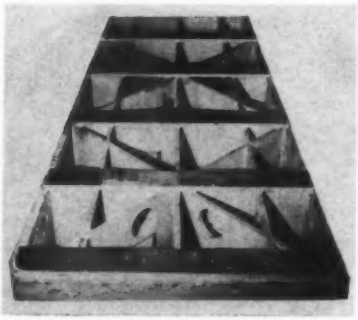


Fig. 3. Top view of a machine base weldment. Even though the shell appears to be thicker than the ribs here, this relationship can often be reversed.

photo-elastic model stress analysis can be very helpful.

It's done by placing a proportionally stressed or deformed transparent model in a polarized light. By increasing the magnitude of applied loads there results a visual increase in "fringe" light density; thus stresses can be analyzed. In Figure 2, stress concentrations appear in the weld fillet and corners.

Severity of residual stress varies with cutting, working, or temperature gradients applied to steel. So it is when plastic materials are cut; their internal condition is similar to that of metals having similar treatment.

Fig. 4. This boring machine is made on a production basis. The bases are the same although other components are special — a good candidate for polarized light model evaluation.

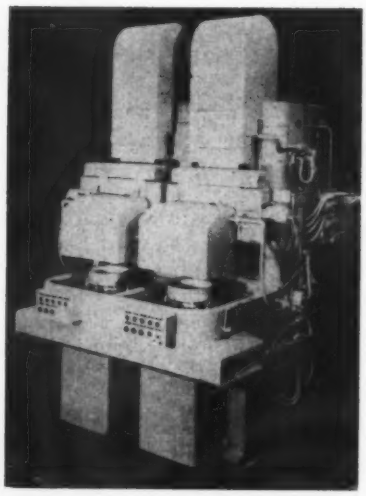


Table I

Cost Schedule

	Casting	Weldment
(1) Lead Time		
a) Engineering Design of Base	80 hrs ($380)	80 hrs ($380)
b) Pattern Design & Construction	4 wks ($6000)	0
c) Make Base	7 days	3 days Flame-Cut & Form
d) Snag & Fill Casting	3 days	1 day Stress Relieve
		2 days Setup
		2 days Weld
		1 day Stress Relieve
		1½ days Rough Machine
		1 day Grind
		1 day Final Stress Relieve
Total Time	8 wks	4½ wks
(2) Construction Cost of Base	13,810 lbs @ approx. $0.23/lb ($3,176)	11,050 lbs @ approx. $0.242/lb ($2,682)
	Stress Relieve ($140) (Does not include pre-machining)	Including Pre-machining & Stress Relieving
Total	$3,316	$2,682
(3) Summary:		
a) Lead Time	8 wks	4½ wks
b) Cost	Pattern ($6,000) Base ($3,316)	($2,682)
Total	($9,316)	$2,682
	Cost Saving Resulting From Use of Welded Construction	$6,634
	Time Saved Using Weldment	3½ wks

When joining, plastic must be reduced to a liquid at the joint. This resembles a steel weld. A good method is to use a solvent such as methylene dichloride. A few test joints will help to become familiar with the technique. (Another hint for bending plastics is to apply heat through a narrow slot in asbestos. With this procedure it's easy to bend along a line.)

Although minor imperfections will not show up in a photo-elastic examination, an attempt should be made to obtain optic clarity by careful fitting. Clouding sometimes is caused by atmosphere moisture. Movement of the joint edges before a "set" takes place will cause bubbling and crazing within the bead. Grinding the edges can improve contact fitting.

Design Evolution and Analysis

Successful design is often the result of a compromise between all the desirable characteristics: for example, strength vs. weight. It's the designer's responsibility to bring together the proper characteristics for a satisfactory end result.

In designing a new base, or in the re-evaluation of an existing base, the envelope and capacity are generally known and loading forces can be roughly estimated from a knowledge of the tooling and fixturing to be used. With these known factors, three of the desirable characteristics for a finished base are: High strength, simplicity, and a discreet use of standardization.

Where tool forces are high and heavy slide forces work rapidly, they may be closely calculated by mathematical analysis. The analysis can determine whether the machines should be horizontal, vertical, or a combination of both. Arriving at this point, the scaled down model can be made.

Loads to be applied to the model

for polarized light evaluation can be approximated from the following relation:

$$P_m = P_p \frac{E_m}{E_p} \times \text{Scale}$$

where P_m = Model force (lbs).
P_p = Known Prototype force (lbs).
E = Modulus of Elasticity.
Scale is expressed as Model Size/Prototype Size.

By being able to see elastic deformation in the areas where stress is proportional to strain (E), we are provided with a way of estimating the model loads. (See illustration at right.)

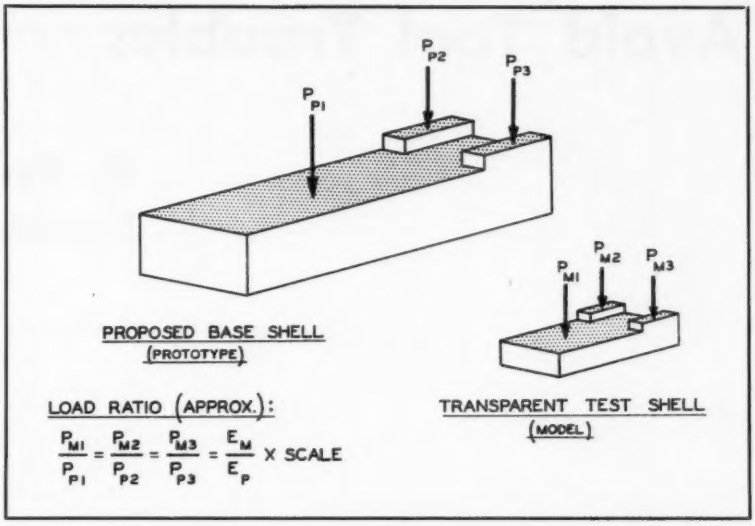
After test loads have been determined, the model is placed in a photo-elastic polariscope where a fixture applies forces and rotates the model in polarized light. Forces are applied lightly at first and increased slowly until stressed areas appear as brightly lighted spots. If loading continues, the bright spots will develop fringe lines indicating over-stressed areas. If fringe lines appear before pre-determined loads are reached, the model should be removed from the loading fixture and allowed to recover from its deformation. After recovery new structural members are "welded-in". The model is again stressed under the light and additional ribbing added until rigidity is sufficient to support all the pre-calculated loads.

Safety factors may be included by the use of additional members, but good judgment must be exercised in order to preserve the simplicity arrived at thus far.

When ready, the model will serve as a direct reference for draftsmen producing the finalized machine base drawings; it can go with blueprints to the fabricator.

Cost Factors

The designer must keep cost in mind, along with other design factors, if he is to be completely successful. With the competitive picture becoming more complex, at home and abroad, it is imperative that the machine tool builder scrutinize his designs to "wring" every penny of unnecessary costs out of the "build-expense."



A cost factor that is often sadly neglected is the leadtime required to get a base fabricated. Welded construction offers tremendous help along this line.

Cost figures for the base of a special tape controlled machine are are shown in Table I. It should be noted that certain figures have been estimated or rounded off, but all data has been taken from actual records and other authoritative sources.

Application

There are those who may wonder about the cost of constructing scale models and taking calculations from them. This cost is easily offset in the final drafting stage by the having of a model for reference.

Requirements and application of the base in Figure 3 demanded that all deflections be held to an absolute minimum. Even with this demand direct economies were realized. Even greater savings can be had when polarized light evaluation is applied to standard machines produced on a production basis.

It is often found that shell plates can be reduced from 1" thick to ¾" while the internal members remain 1" thick. In one particular case this resulted in a final weight of 6300 lbs, as compared to the original 7100 lbs. This not only resulted in a direct material savings of more than $150 but brought about a very important savings in other areas. Bending, forming, flame and saw-cutting, erection and welding, and general handling, were all improved through the build cycle.

This method of evaluation and construction is not a cure-all for every job, but it's certain to bring about refinement in all.

Editors Note:
Mathematical derivation of stress-strain relationship will be sent on request.

Extra copies of this article are available while supply lasts. Write Tooling & Production Magazine, 1975 Lee Rd., Cleveland 18.

Coming Next Month:

A Special Engineering Report on Boring

Avoid Tool Troubles - -

By Proper Selection and Treatment of Tool Steels

by Arthur F. Torok

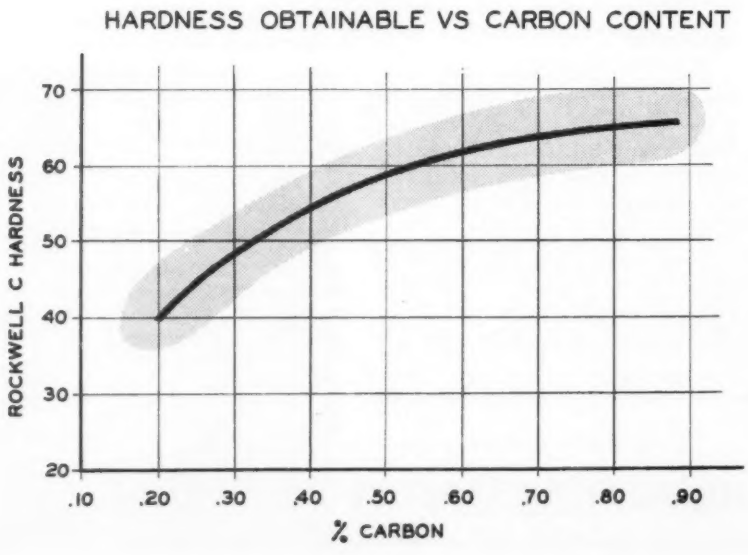
Mr. Torok is Chief Metallurgist of National Acme Co., Cleveland, Ohio. His years of toolroom experience and daily troubleshooting in the heat treating and machining departments of the company give him an intimate knowledge of tool steel problems.

Tool performance depends on choice of the right material and treatment for the job on hand. The cost and processing advantages of each tool steel grade are important factors which influence the selection of tool materials. Proper heat treating and handling can save money and headaches for tool makers and users.

AS LEADERS ARE AMONG MEN, tool steels are among metals; both give purpose to their own kind. Patience in man is wear resistance in steel, perseverance is red hardness, and so on. Extra care is warranted in the selection and treatment of both, for as the leaders determine the economic climate of business, so it is with tools and machines.

Each month, 14,000,000 lbs of tool steel are transformed into working implements. The cost of the raw material, however great, is only a small fraction of the value of the finished tools. Thus the selection and treatment of tool steels should be based on much more than material cost.

Figure 1.



Selection Factors

There are 83 AISI tool steel types, but with varying carbon contents available the number of different steels is probably over 100. This does not include cast materials and carbides.

The base prices range from $0.33/lb to $4.33/lb. A commonly overlooked factor in comparing tool steel prices is density, or lbs/cu in. This is significant in the highly alloyed materials. For example, an M-2 type of high speed steel is about 6.7% lighter than an 18-4-1 or T-1 type. Of course, this means that 6.7% more ma-

Table I. Comparison of Representative Tool Steels.

GROUP AND TYPE		ANALYSIS (Elements by %)	COST $/Lb. (Base)	CU IN/LB	CLASS OF EXTRAS*	MACHINABILITY** %	GRINDABILITY***
Water Hardening	W-1	.60 C to 1.40 C	.33	3.53	TS	45	1
	W-7	1.0 C, under 1% alloy	.51	3.53	TS	45	1
Shock Resisting	S-1	.5 C, 1.5 Cr, 2.5 W	.64	3.53	TS	30	2
	S-2	.5 C, 1.0 Si, .5 Mo	.37	3.53	TS	35	2
Cold Work							
Oil Hardening	O-1	.9C, 1.0 Mn, .5 Cr, .5 W	.51	3.53	TS	35	3
	O-7	1.2 C, .75 Cr, 1.75 W	.53	3.53	TS	30	3
Air Hardening	A-2	1.0 C, 5.0 Cr, 1.0 Mo	.54		HA	30	3
High Carbon-High Chromium	D-1	1.0 C, 12.0 Cr, 1.0 Mo	.96		HA	20	4
Hot Work							
Chromium Base	H-11	.35C, 5.0 Cr, .4 V, 1.5 Mo	.51		HA	30	3
	H-14	.4 C, 5.0 Cr, 5.0 W	1.02		HS	25	3
Tungsten Base	H-20	.35 C, 2.0 Cr, 9.0 W	1.43		HS	25	3
	H-26	.5 C, 4.0 Cr, 1.0 V, 18.0 W	1.84	3.19	HS	22	4
High Speed							
Tungsten Base	T-1	.7 C, 4.0 Cr, 1.0 V, 18.0 W	1.84	3.19	HS	20	4
	T-6	.8 C, 4.5 Cr, 1.5 V, 20.0 W, 12.0 Co	4.33	3.11	HS	16	5
Molybdenum Base	M-1	.8 C, 4.0 Cr, 1.0 V, 1.5 W, 8.0 Mo	1.20	3.51	HS	24	5
	M-15	1.5 C, 4.0 Cr, 5.0 V, 6.5 W, 3.5 Mo, 5.0 Co	2.62	3.77	HS	15	6
Special Purpose							
Low Alloy	L-1	1.0 C, 1.25 Cr.	.51	3.53	TS	38	1
Carbon-Tungsten	F-2	1.25 C, 3.5 W	1.22		HA	30	2
Mold Steel	P-2	.07 C, 2.0 Cr, .5 Ni, .2 Mo	.33	3.53	TS	66	

* Extra costs are determined by the class of steel: TS - Tool Steel; HA - High Alloy; HS - High Speed.

** Machinability of AISI type B-1112 is taken as equal to 100%.

***Ease of grinding in order of increasing difficulty. 1 is easiest, 6 is most difficult.

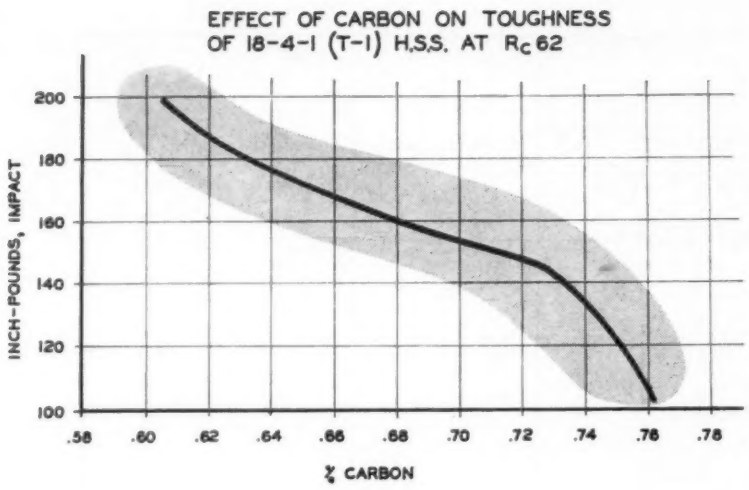


Figure 2.

terial is obtained per pound purchased.

The machinability of these tool steels varies over a ratio of 3:1. The surface finish and cost of many tools are direct functions of this property. Machinability affects costs from the cut-off department through milling, drilling, turning, and tapping.

Free machining grades of tool steels are now available and are reported to give up to 40% improvement in machinability. The effects of the free machining additions on certain properties are still being discussed in metalworking.

The grindability of these steels varies over a ratio of 6:1 in the hardened condition. The effect of a particular type of steel on grinding costs is particularly important where complicated geometries and close tolerances are involved, such as in form and crush grinding. If the form of the wheel breaks down rapidly due to the abrasiveness of the tool steel, operations become more expensive.

The alloy content of tool steels varies from less than 1% to nearly 40%. Since the alloy content determines the properties of the tool, a knowledge of the effect of various alloying elements is necessary for the intelligent selection of tool materials.

Carbon content is especially important and will be treated briefly. The hardness that can be obtained in a given steel is a direct function of carbon content up to about 0.70% carbon (Fig. 1). Beyond this range carbon is responsible for the formation of carbides of certain alloying elements, when sufficient amounts of these elements are present. Hardness and the amount of carbides determine such properties as wear resistance and cutting ability. The effect of carbon on toughness is illustrated in Figure 2.

Table I lists representative tool steels by type, grade, composition, cost, grindability, and machinability. The particular application usually narrows down the selection to a few types. The Table can be used to compare individual grades from a cost and processing standpoint.

Causes of Poor Performance

Once the proper grade of steel is selected it must be properly heat treated to assure optimum results. An understanding of the metallurgical principles of tool steel heat treating pays off in terms of better performance (see "Heat Treatment of Tool Steels," T&P, March 1960).

One of the most common causes of poor tool performance or tool failure is improper heat treatment. The presence of surface layers containing lower percentages of carbon than normal for the grade can lead to serious trouble. This decarburization can be caused by oxidizing atmospheres or unrectified salts.

Insufficient stock removal after heat treatment can also be the cause. A handy guide for proper stock removal on various sizes is given in "The Steel Products Manual—Tool Steels," issued by the American Iron and Steel Institute.

Similarly, the presence of surface layers containing higher percentages of carbon than normal for the grade can contribute to tool failure. Again, this is caused by the media surrounding the work while it is heated.

Improper tempering is another cause of tool troubles. Insufficient tempering time or temperatures, too high a tempering temperature, or tempering too soon or too late from the hardening temperature, must be avoided.

Poor performance or failure is often caused by factors other than heat treatments. Many failures are due to use of the wrong material because of improper identification in storage or processing departments. Considering the relative costs of these materials, thorough identification is certainly warranted.

Grinding can generate surface heats of over 2000°F, and thus can have the effect of an unwanted heat treatment. Improper grinding may result in overtempering, or in some cases may produce surfaces which are rehardened and untempered. High residual stresses, and even micro and macro cracking also may result from grinding. Improper heat treating can cause some of these grinding difficulties.

Rough surface finish or careless stamping in critical stress areas can drastically shorten tool life. Water hardening grades of tool steel have cracked in heat treating from these causes.

The best solution to all of the above causes of poor tool performance is good equipment in the hands of men who understand their work.

Special Treatments

Special treatments are worth investigating because great improvements in tool life and productivity

can often be gained when they are properly applied. The treatment to be used, if any, is determined by the analysis of the material and the application of the tool.

Liquid nitriding is probably the most common special treatment encountered. It produces a shallow, nitrogen-rich surface which has extremely high hardness and a low coefficient of friction. A finish ground tool can be treated in less than an hour. In some cases tool life has been doubled by this treatment.

Surface impregnation and plating, although often costly, are warranted in some applications. The result is improved wear because of the better frictional and anti-weld properties imparted to the surface of the tool.

Special finishing operations such as honing, polishing, and vapor blasting have the effect of distributing the stresses evenly over the smoother tool edge, and therefore, theoretically, alleviating notch effects and frictional forces.

Flush or fixture quenching has been most commonly applied to header dies made of water hardening material. Exceptionally good results have been obtained in this manner. The microstructure and hardness of these flush-quenched tools are the same as for conventionally quenched tools. Residual stresses which are imposed during quenching tend to strengthen the material.

Some of the most satisfying results have come through the application of martempering to tool steels with good hardenability. The treatment limits distortion, even to the point of eliminating a grinding operation. The principle involved is to cool the steel from the hardening temperature to the temperature where martensite begins to form. It is held at this temperature until the temperature is uniform throughout the tool, and then is cooled in air to complete the hardening process.

Many other treatments have been suggested and certainly new ones will be developed. They warrant study and judicious testing.

Performance Case Histories

Some examples of tool steel performance problems and their solutions are described here to illustrate principles already covered.

A trimming die used to cold trim the flash from alloy forgings was made of a high carbon-high chromium type of tool steel. Life was erratic and unsatisfactory; the number of trims varied from 6000 to 15,000 before production was interrupted by the rolling over or chipping of the die edge. Through microscopic examination of the edges the trouble was traced to poor heat treating atmosphere control, as evidenced by decarburization of the rolled-over edges and carburization of the chipped edges. These dies are now treated in properly controlled atmospheres and give 70,000 trims or better before production is interrupted.

Plug gages made of D-3 type tool steel had changed size over a period of two years, and caused an inspector more than a few gray hairs. A gage was sacrificed to the microscope and showed the presence of residual austenite and untempered martensite, undesirable constituents resulting from improper heat treatment. The old gages were put through a series of tempering and freezing cycles, reground and put into service. They have held size for three years. Of course, all critical gages at this company now receive this treatment.

A cold forming die subjected to high, intermittent compressive stresses failed by spalling on the working surfaces. Examination by Magna-glo indicated the presence of a characteristic grinding-check pattern. Close control of the grinding operation solved this problem.

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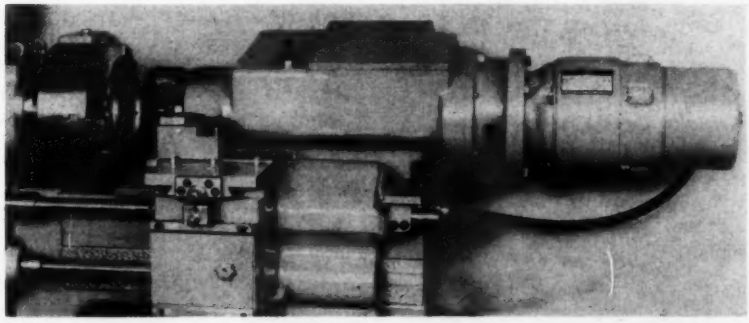
Machine Does Five Jobs In One Cycle

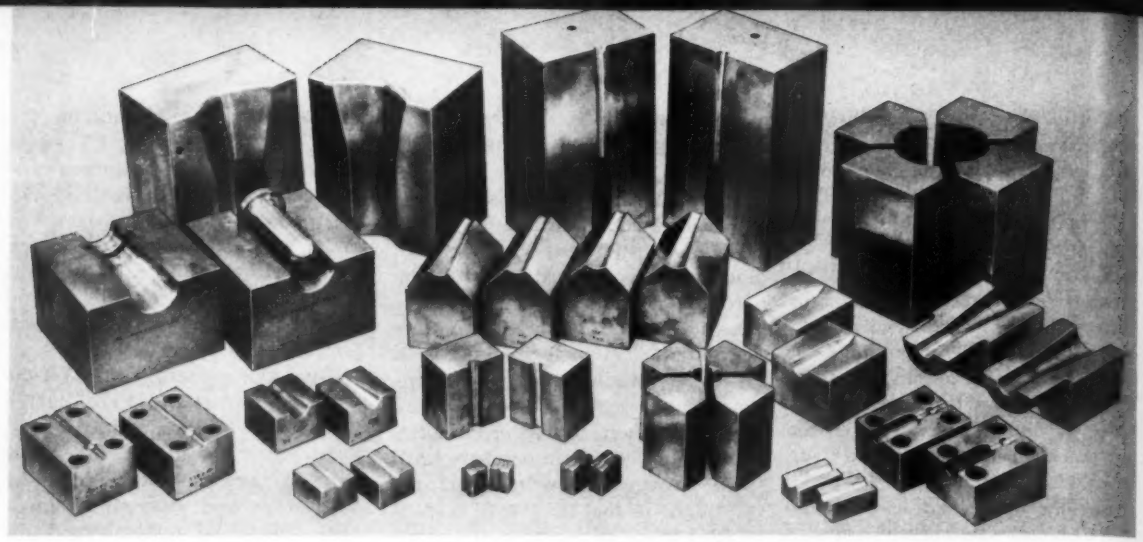
When you do five operations simultaneously on a single machine in a single cycle, chances are you are saving money in direct labor, pieces/hr, material handling and floor space.

A Seneca Falls Machine Co. motorized drilling head, attached to one of their Lo Swing automatic lathes, has enabled one auto manufacturer to realize just such a savings by turning, facing, and grooving the large diameter of the direct drive clutch while the center is simultaneously being drilled and reamed.



The special drilling-reaming attachment is used in place of a standard tailstock. It's an electrically-driven, self-contained unit controlled by its own feed cam, and it provides fine feed for drilling and coarse feed for reaming.

Two tools on the front carriage turn separate diameters. Three tools are mounted on the rear tool block; two perform facing operations, the third a grooving function. All tools, including the drill, work simultaneously. The main headstock drive maintains a constant speed for turning the larger diameters, while the motorized drilling head provides proper speed for drilling and reaming.



Fourth of a Series

Tooling Up a Rotary Swager

by Keith Bernhardt

The first three articles of this series covered what swaging is and what it can do, the metallurgy involved, and the choice of a swager. See T&P, Oct. & Dec. 1959, and Feb. 1960. Mr. Bernhardt, a graduate engineer with the Fenn Manufacturing Company, offers here more useful information.

DIES FOR SWAGERS can be divided into two categories: 1) Dies to produce finished parts for function and/or appearance, and 2) dies to be used in pointing operations for redrawing. The first category is self-explanatory, whereas it should be mentioned that a pointing operation is required on mill stock prior to threading it through a draw die. In pointing, appearance is not a factor but it is essential that the material have enough tensile strength to withstand the redraw pull.

The chief design difference is that pointing dies are usually more oval than finishing dies and their straight portion, or blade area in the back of the die, is much longer. The entire length is used for reduction, so pointing will not have to be repeated for subsequent drawing operations.

Know-how based on previous experience is helpful when designing and manufacturing swaging dies. As a rule, most complicated parts require at least one experimental set of dies before a suitable finish-set can be made. Swagers should be willing to underwrite this expense since, ultimately, they will be well rewarded by increased production and better parts.

Since swaging is effectively reducing a large diameter to a smaller one, there is a tendency for the metal to flow laterally as well as axially. This makes it essential that the sides of each segment of the die cavity be relieved at its edges to avoid a shaving action.

If you look at the cavity of a well-made die you will observe an elliptical condition as the sections are brought together. Even though the cavity may be dead-round, relieving the edges gives an elliptical appearance. This condition should be increased or decreased according to the material wall thickness. Normally, for very thin walls the cavity is not relieved much; as the wall thickness increases, relieving should increase. This is very important since it is possible to overwork the material to the point

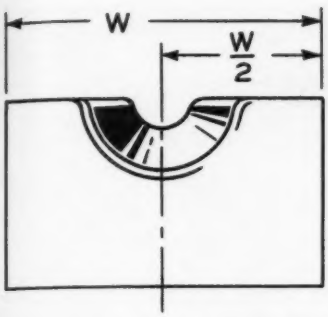


Fig. 1. The die cavity must be centered so that each segment shares equally. Dimensions here would normally be held to ± 0.0005".

where its physical characteristics are lost, or never attained.

In effect, this does to the metal what can be compared to the kneading of bread—working the material from the outside in. When working solids the oval condition must be even further increased since the flow volume is greater. If a solid piece shows a bulging effect in its center after swaging, you can be sure the material was thoroughly worked. If the center is concave, only the outside edges were worked and good swaging was not achieved.

Relief at the edge of the die cavity is also important from the standpoint of feed rate. Proper relief is a cut-and-try proposition which should be accomplished in gradual steps since it is possible to relieve a die too much, making it worthless. Insufficient relief is usually indicated by a wrinkling of the surface, or scuffing, in the case of a solid. Insufficient relief also creates a friction-drag great enough that it may be impossible to hold the work from turning at the same rpm as the spindle. A gradual relieving will correct this.

Material which must pass **through** the blade of the die to the rear of the swager and then be withdrawn **back through** the front again for extraction, requires a slight taper, with its small diameter toward the rear of the blade. This design is essential because when most work is removed it tends to "spring back" somewhat to its original shape. This means that the work which has passed through the blade is actually larger than the die, making it impossible to draw it back through.

Practical experience will determine the extent material will change shape after swaging. Usually, it is best to design a die on the small side and rework it to obtain required dimensions. Note that spring-back will vary from material to material and from machine to machine.

All dies should be designed with sufficient lead-in-angle to accommodate oversized material or misalignment as work enters the die. It is essential, too, that they be designed to accomplish reduction within the confines of hammer dimensions. It is possible to extend the die length beyond hammer dimensions by overhang. However, no work should be done in this area. Usually, an overhung die lends itself to supporting a mandrel or a stop arrangement.

The use of the proper die steel is critical. For instance, hot swaging requires a different die steel than that used for dies that will swage common materials. Where extreme abrasion is anticipated, die steels having chrome, molybdenum, and vanadium should be considered. Although machining and material costs will be higher, it will be justified by longer life and lower maintenance costs.

Even with proper design, no die will work unless the swaging machine is delivering a full blow and the dies are closing completely when receiving it. If clearance between work and die are allowed as the hammer passes beneath the rolls, the die may split. A careful setup for proper closure with the right shims is the answer. Split dies may also result from too light a hammer blow, improper cavity, not enough side clearance, or not enough relief.

A workpiece whose point is to be concentric with the unswaged portion can best be had if the die incorporates a long pilot section in the front of the die. This serves to permit swaging steeper angles, as it holds the work and reduces kickback tendency.

The portion of the work remaining in die-contact the longest is usually smaller in diameter than the part being swaged the least. Therefore, to reduce this variation and to hold tolerances, the blade of the die can be shortened to reduce the overall time any section of the work is in die-contact. Then, too, the shallower the working angle, the greater the work contact area at all times. But, angles too shallow may result in machine-overloading.

A machine's size and application help determine die design. Many times it is impractical to take small

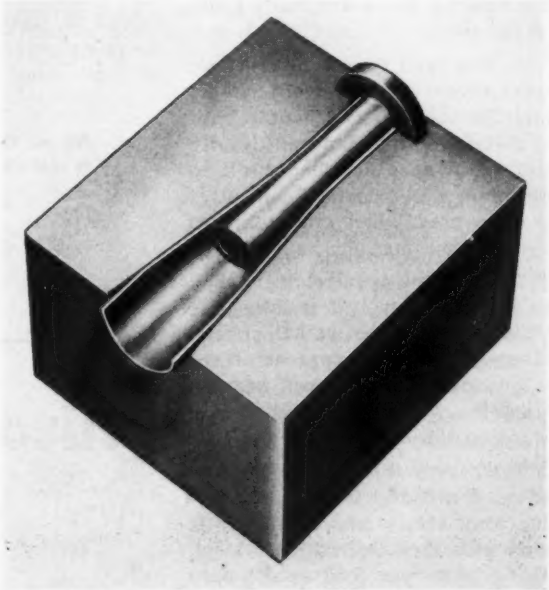


Fig. 2. A typical work stop. Sometimes they are mounted in the spindle and made adjustable. This one is a component of the die and also works as a mandrel.

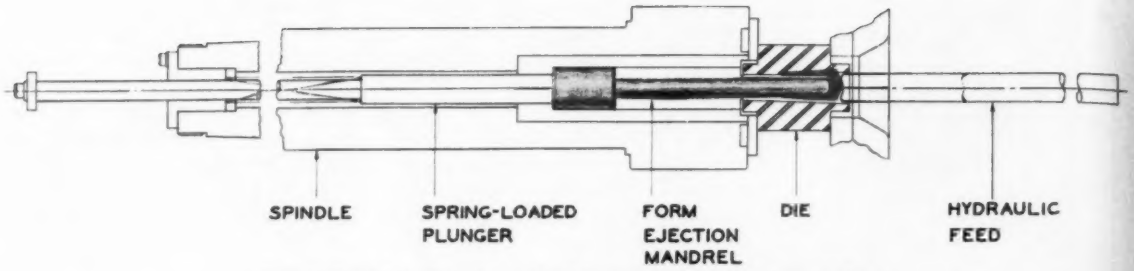


Fig. 3 Special tooling for a lipstick case. An ejector type spring loaded mandrel prevents collapse of the thin-walled part and also does the ejecting.

reductions on large diameters, in a number of passes, to obtain overall reduction. But, it can be done where production rate is not vital and budget requires that one machine do a wide range of work.

If this is the case, a machine's load can be reduced by increasing the angle of taper in the die. Reducing the work load this way increases the manual work of the operator since the axial driving force is greater. In some instances this may result in the need for a feed fixture. (Feed mechanisms will be discussed in the next article of this series.)

Mandrels

Whenever tubing must be formed to a given wall thickness it is essential that a hardened mandrel support it from the inside. A mandrel has an ironing effect, inside, while work is being done on the outside. There are many types of mandrels:

1. The hand type is used where workpieces are relatively simple and the operator can handle both the work and the mandrel. Usually though, it does not lend itself to optimum wall thickness control; it is only used when attempting to avoid wrinkling.

2. When the mandrel is attached to a feed-fixture it is usually possible to control the wall thickness. However, with this approach there is a tendency for the wall to grow since the work tends to slide forward on the mandrel.

3. On very thin walls a pre-positioned mandrel is used, in conjunction with a feed arrangement such as a rack and pinion system. Using a known feed is the only way to control wall thickness consistently.

4. The most common mandrel system is the built-in type (Fig. 2). These serve in a number of ways, such as a stop to control length and ID, and they will not scuff inner surfaces since they are free to rotate with the work.

5. The plug-type mandrel (Fig. 3) is similar to that used on a Draw Bench. Either seamless or welded tubing is swaged over the mandrel, which partially extends into the reducing section of the die, partially into the blade. This system is usually used for long lengths of tubing where it would be impractical to make a full length mandrel.

Regardless of what mandrel you use, its use makes die design more critical since it is essential that the work be swaged and also be left free on the mandrel.

Side relief, as previously discussed, is important to accomplish stripping action. Again, the amount of side relief is determined by starting with a slight relief and increasing gradually until proper swaging and stripping occurs. Remember, too much side relief can be detrimental: it may produce an oval condition and effect an oversize OD. To compensate, an undersize mandrel will help. However, no two problems require the same approach. Swaging the same configuration on swagers of different sizes will not produce the same results.

Considerable experimental work is being done on special mandrels that are similar to tapping or threading devices. We have found it possible to form an internal thread or a riffling effect by reducing oversize tubing over these mandrels. For stripping, it is necessary to unwind each part. This approach makes it possible to produce parts impractical to machine.

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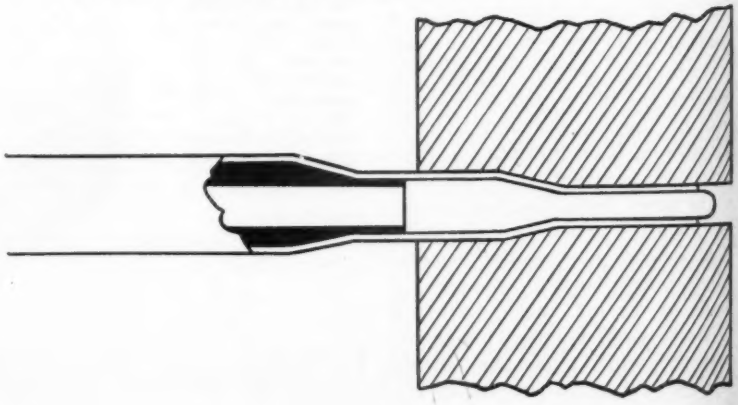
Fig. 4. The plug mandrel is usually used where parts are too long to make a full length mandrel practical.



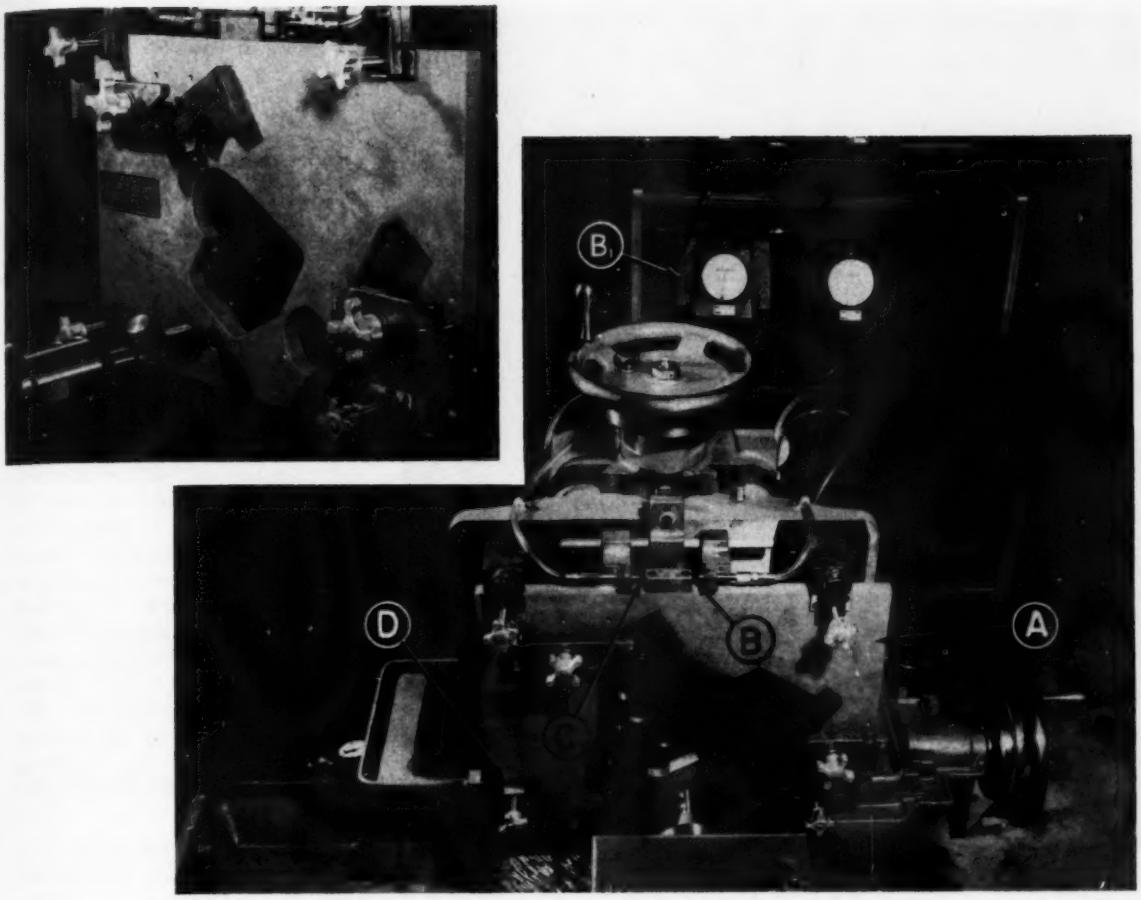


Fig. 1. The basic setup for high accuracy boring. The magnesium tooling plate (A), mounted on the Heald Universal boring fixture, has been positioned by the electronic gage (see inset) so that the boring spindle is concentric to its master bushing within millionths. The Dimensionair (B_1) is zeroed in to monitor the basic setup; the AirProbe spindle nose contacts the locating block. The AirProbe for boring the reverse side of the part (C) does not contact the locating block at this time. "D" is one of 10 hardened pads attached to the tooling plate.

Pictures Show G.E.'s

High Accuracy Production Boring

HOW DO YOU GET much more than the rated accuracy from a production boring machine? The Armament and Control Section at General Electric Company's Johnson City, N. Y., plant found a way, with surprising success, of achieving jig borer accuracy on a production basis. Hole locations on gear cluster housings and similar small parts are being held within the required tolerance of ± 0.0001" on virtually 100% of the work.

The system for up-grading this boring operation, as developed by

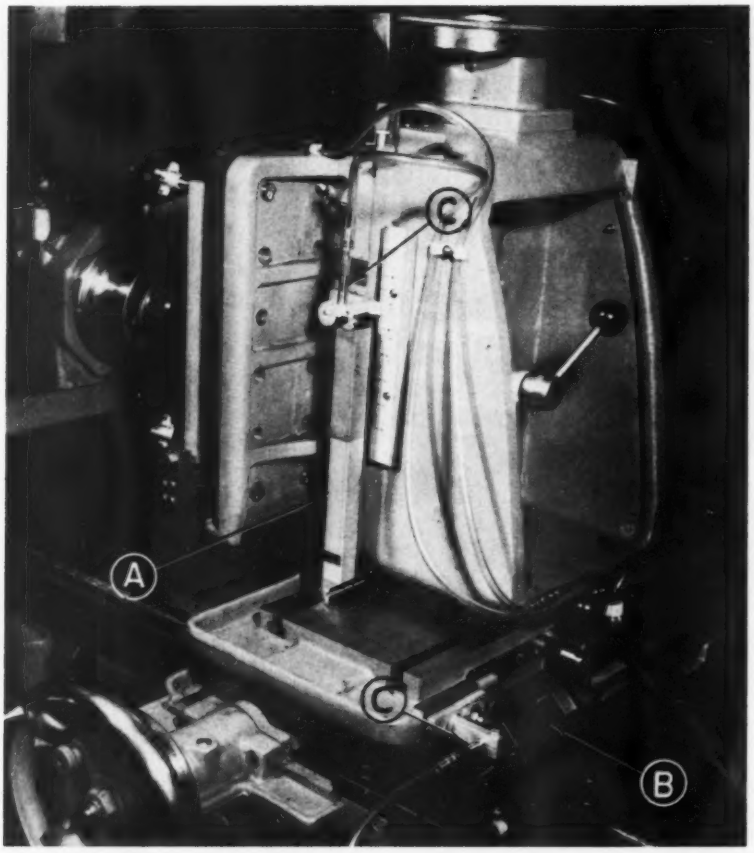


Fig. 2. Gage block stacks determine hole location coordinates. "A" blocks are for the Y, or vertical, components; "B", for the X component. The air gage probes (C) contact the blocks. The operator adjusts the handwheels or boring fixture to get zero readings on the air gages.

Oren Olmstead, Methods Technician, and Clayton E. Granger, Quality Control Specialist, involves:

1. An Ex-Cell-O horizontal boring machine which was re-worked by scraping the ways and precisely aligning the spindle with them.

2. A Heald universal boring fixture, which was also reworked to provide scraped ways to permit a virtually perfect 90° relationship to the machine ways.

3. Federal Dimensionair air gages and AirProbe heads to monitor the basic setup and hole location accuracy.

4. DeVlieg Flash Change toolholders which are capable of being preset off the job within a total radius tolerance of 0.0001".

5. A magnesium tooling plate with master bushing, which is aligned concentric to the spindle for the zero, or starting, location.

The tooling plate, which holds the part to be bored, is positioned on the Heald fixture by means of locators, and securely clamped in place. The hardened pads of the tooling plate seat against the carbide faced locator pads of the boring fixture to eliminate any chance that burrs might throw the plate off location.

The master bushing (which was ground and lapped to 0.000020") in the plate is aligned concentric to the spindle with a Cleveland Indiac electronic indicator (Inset, Fig. 1). This alignment is accomplished by making the necessary X and Y adjustments on the Heald universal fixture. When final alignment is achieved, a Federal Dimensionair monitors the zero or initial setup (Fig. 1).

The amount of indexing along the horizontal and vertical axes (X and Y coordinates) required for each hole is determined by sets of gage block stacks, which are sent to the floor with each job. A Federal Dimensionair is zeroed in on each stack (Fig. 2) to position the fixture and monitor the accuracy of hole location. These gages can be set quickly because adjustment does not change magnification. Setting requires only one master.

The first part of the run is bored undersize and the tooling plate removed with the part in place to undergo a complete check. Two edges of the tooling plate bear a very accurate 90° relationship so the hole locations can be checked quickly. When the part checks OK, proving out the designer's calculations, the plate is replaced in the machine and re-positioned. The part is then bored to size and the remainder of the lot machined with essentially 100% in-tolerance results.

If the opposite side of the part must be bored, there is sufficient separation between plate and fixture to allow 180° rotation. When the plate is repositioned the setup is monitored by another Federal gage.

Olmstead and Granger report that the system is not only accurate, but also fast enough to qualify, economically, on a production basis. Care is necessary to get fullest results. Rapid tool advance and return is not allowed, for example, nor is the operator allowed to rest his foot on the base pedestal. This deflects the system by as much as 0.0003". G. E. experience indicates that this setup gives the operator a true feel for the close limit work he is performing. end

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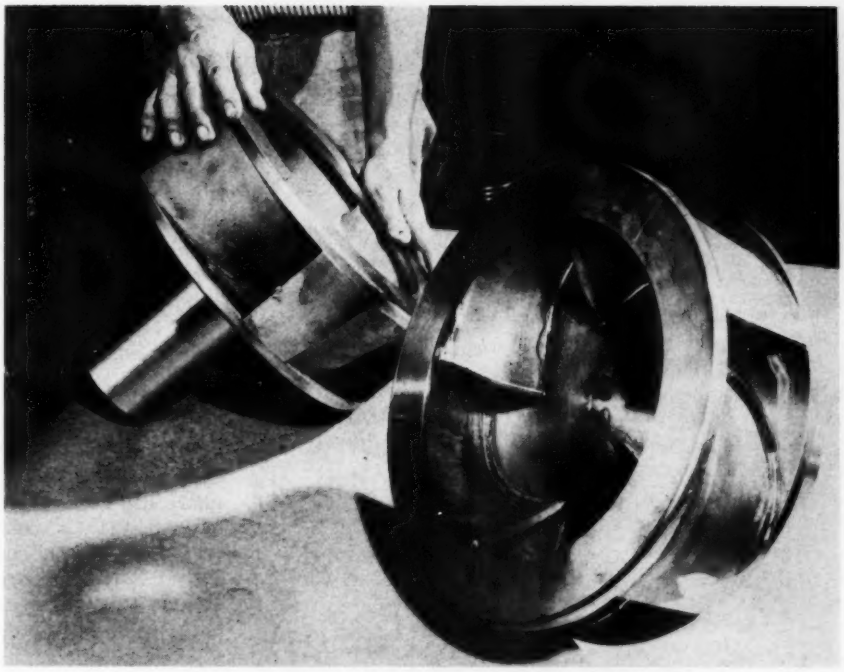

Fig. 1. Titanium impeller at left was cast while the one on the right is a weldment. Both proved satisfactory.

Don't Wait for Tomorrow to

Fabricate Titanium

by Burton Payne

Mr. Payne is Manager of the Metallurgical Department of Pfaudler Co., a division of Pfaudler Permutit, Inc., Rochester, New York.

Since early titanium machining presented many difficulties, mostly due to relatively impure base metal and an ignorance of titanium's idiosyncracies, it came to be known as "difficult to machine." Present day improvements in titanium production, and a better understanding of its properties and their influence on machinability, have done much to relieve this undeserved reputation. New welding techniques also make it possible to use titanium's unique combination of properties to advantage. There are rules, however, that now exist that should be carefully followed.

TITANIUM'S RESISTANCE to corrosion makes it highly useful for process equipment. It resists nitric acid, most inorganic salts, and many other corrosive media, over a wide range of concentrations and temperatures. It is also more resistant to stress corrosion and pitting than is stainless steel.

Fabrication of titanium has presented many problems, for its working characteristics differ from most other metals. When cold formed, it has strong spring-back tendencies, and special techniques are required for welding since it

Fig. 2. Components of all-titanium pachuca pumps.

cannot be welded to any other metal. Also, like zirconium, it has an affinity for oxygen, hydrogen, and nitrogen during the welding process.

In the past few years, Pfaulder Co. has developed some interesting techniques for fabricating process equipment from the various "wonder" metals. The methods used to fabricate a pachuca pump are described below.

All-Titanium Pump

The pump is used to clarify a highly corrosive nickel chloride solution in a pachuca tank—a wooden vessel approximately 15′ x 30′ dia. In process, the pump is suspended from the top and a 10″ dia, 25′ long rubber suction hose is attached to the bottom of the pump; the other end is immersed in the electrolytic solution. The pump pulls the corrosive medium up through the rubber hose and sprays it back into the tank. This continuous agitation causes impurities to float to the top, where they can be skimmed off.

Prior to installing the titanium pump, a massive stainless steel pump was used. The new titanium pump is only 23-7/8″ long, has a 14″ dia impeller, and weighs less than half as much as the stainless one.

Pfaudler performed all machining, cutting, triming, and welding operations. Both cast and welded titanium impellers were fabricated for evaluation, and both proved satisfactory after testing (Fig. 1).

Polishing various portions of the pump presented no particular problem; it merely required an adherence to the mill recommendations. Titanium can have a high polish, although slightly inferior to that of most stainless steel alloys.

Titanium is not difficult to machine. It does, however, present problems somewhat different from those found when machining carbon or stainless steels. Once these problems are solved, it is actually easier to machine than stainless steel.

The titanium being produced today has a better microstructure than that produced in the past. The very hard titanium carbides have been eliminated through improved processing.

Effect of Properties

There are several reasons why titanium initially presented more resistance to machining than other more usual materials: 1) It has a tendency toward seizure or galling. 2) It becomes chemically active at elevated temperatures and minute particles weld to the tool. This dulls the tool and further elevates the temperature. 3) Its relatively low thermal conductivity prevents the dissipation of heat. 4) Chips curl away from the tool in tight curls with little edge build-up resulting in localized stress concentrations raising the temperature even more.

These problems can be overcome by: Directing coolant as close to the point of contact as possible, keeping tools very sharp and using proper attack angles, and using heavy feeds and slow speeds.

The machining difficulties mentioned above are aggravated by an increase in yield strength; and titanium alloys in the 30,000—145,000 psi range (annealed) present different machining conditions than those of the 200,000 psi range (heat treated). With grades that are to be heat treated, as much stock as possible should be removed while the metal is in its annealed condition.

Properly handled, you can expect an excellent surface finish and it does not work harden (appreciably) in spite of earlier tales to the contrary.

Chemical Effects

Early heats of titanium were high in carbon and oxygen. Much of it had as high as 0.8% carbon. Some material, relatively low in total carbon, had high carbon areas

distributed through it. Titanium carbides are extremely hard, accounting for much of the machining trouble. These problems do not exist or are less serious today due to a much better product.

One problem that still exists, however, is that an oxide skin forms on forgings made at high temperatures. It is advisable to grit blast, chemically descale the part, or use a heavy cut on the first pass to get the tool under this hard layer.

Selection of Tooling

A tool that retains hardness at high temperatures is required for machining titanium. Carbide tools are recommended, although they may chip and spall when titanium chips weld to them. It should be noted that carbide tools require rigid machines and setups, particularly in light of titanium's lower shear modulus.

Cast alloy tools have been successfully used at slow speeds and light feeds, and even enjoy a decrease in edge damage from chips. High speed steel can also be used at slow speeds, but is not recommended under circumstances where tool damage is known to be high.

Specific Machining Operations

Specific machining details should be obtained from the producer. But, all standard machining operations can be performed if proper conditions are set up. The principles are the same whether the operation is single-point turning, milling, drilling, tapping, reaming, broaching, routing, power sawing, or cut-off with an abrasive wheel.

Although tolerances on the pump were not extremely critical, good fabrication practice was necessary. There was no room for poor or careless workmanship.

All titanium is difficult to form cold, so all components requiring forming were first heated to 650°-700° F.

Welding Problems and Techniques

Since titanium cannot be welded to carbon steel or stainless without losing its engineering and corrosion-resistant properties at the weld, it was decided to make the pump all titanium (Fig. 2).

Angles were formed by welding two pieces of flat bar stock together, and solid rings and split rings were cut from plate. The impeller vanes were formed from flat bar stock and then welded to the retaining rings to form one section.

A special purge welding technique was used to avoid absorption of nitrogen, oxygen, and hydrogen at the high temperature necessary. Absorption of these gases during welding greatly reduces the ductility of titanium, making subsequent bending and forming operations very difficult. Gas absorption also seriously reduces the metal's resistance to corrosion. Pfaudler's technique resulted in a weld that is as ductile and resistant as the parent metal.

It was done in an inert argon atmosphere, requiring a purge chamber (Fig. 3). Argon was continuously introduced into the chamber, under pressure, thus displacing air and establishing the proper atmosphere.

Vacuum chamber welding would also be suitable for welding titanium. In fact, a vacuum purge chamber gives the finest inert gas atmosphere attainable for welding titanium, zirconium, tantalum, and other refractory or reactive metals.

Rubber gloves extending through the sides of the chamber were used to facilitate movements necessary to complete the weld. Standard welding equipment was used.

At present, welding of longitudinal seams is accomplished in open atmosphere by mounting the edges to be joined in a hold-down fixture that has a backing mandrel. The mandrel is usually constructed with a copper backing insert grooved to the required depth and width.

It is important for the surface of the titanium to be in immediate contact with the copper backing

Fig. 3. Operator with hand in rubber glove in side of inert gas chamber to weld titanium.

material and under consistent hold-down pressure throughout the length of the joint. This pressure is usually applied by copper segment pads approximately 2″ long spaced closely together. The pads run parallel with the seam and are located approximately 1/4″ back from the edge of the material.

The necessity for positive and consistent hold-down and a symmetrical relation of the pads cannot be too highly stressed. Adherence to these conditions will produce a weld of consistent size and penetration. When combined with quick and uniform chilling, the possibility of atmospheric contamination is greatly reduced.

When the part to be welded has been properly secured in the fixture, a tungsten inert gas torch is positioned vertically over the joint. The shielding cups used with inert gas welding can generally be used when welding titanium. These provide adequate protection for the molten material directly under the electrode. They are usually larger in diameter than those used for less reactive metals.

The cup-to-work distance should be the minimum possible consistent with good practice. A transparent cup may be used to good advantage because the cup-to-work distance can then be decreased without obstructing the view of the electrode. Shielding cups are always used with open air shielding systems and are sometimes used in closed chamber welding of both the flow-purge and vacuum-purge type.

The torch must be mounted on conveying apparatus that will produce constant motion along the joint. Side-beam carriage type equipment, used in conjunction with an electronic governor, seems to produce the best results. Cold wire feed apparatus may be added if needed. Because constant arc length is important in this operation, a close, parallel relation between the carriage tract and the hold-down bed must be maintained. To ensure close control of arc length, an arc voltage control unit should be used.

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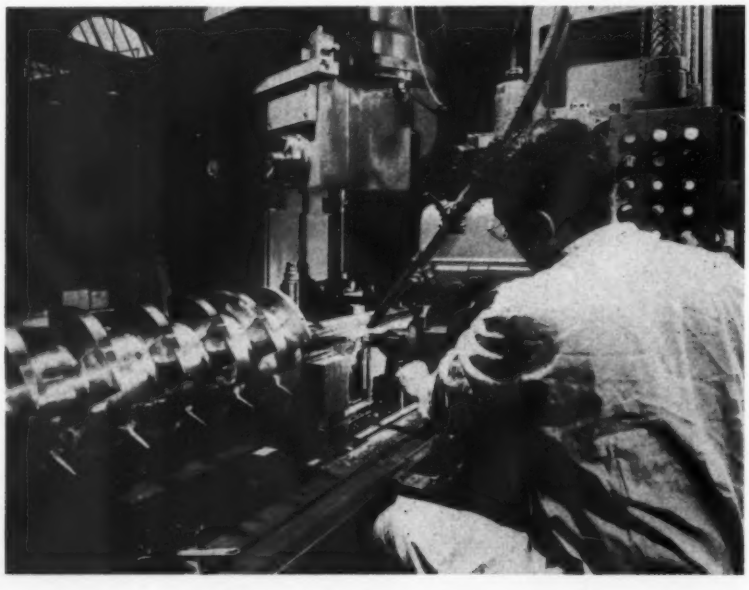
Earns Its Keep Through Versatility

A good special machine tool can earn its keep in ways other than machining, while performing its primary job better.

R. H. Rieder, vice president of Baker Perkins, Inc., says a special new machine installed in the company's shop, a 40′ Cincinnati horizontal spiral milling machine, has reduced manhours more than 40%, both in machining and assembly floor operations on special mixing screws, the primary job of the machine tool.



The unit was specially designed to mill the helix on long steel and stainless steel mixing screws used in a unique mixer—a Ko-Kneader—built in various capacities by the Chemical Machinery Div. to process plastics, food products, adhesives, solid rocket fuels and propellants, carbon electrodes, and friction materials.

Mr. Rieder says it once took 145 hrs to produce an 8″ dia screw; building the core, welding thread segments, machining and hand grinding the flights. The same screw is ready for assembly after 90 hrs work with the new machine.

Because of the accuracy of the machine's divider head, Baker Perkins production people use the machine for cutting keyways in long sand mullers and for making oven shafting, which must be in line and staggered accurately at predetermined degrees. Such shafting can be handled in lengths up to 30′. The universal milling attachment makes the machine a natural for intermittent slotting and continuous spline cutting.

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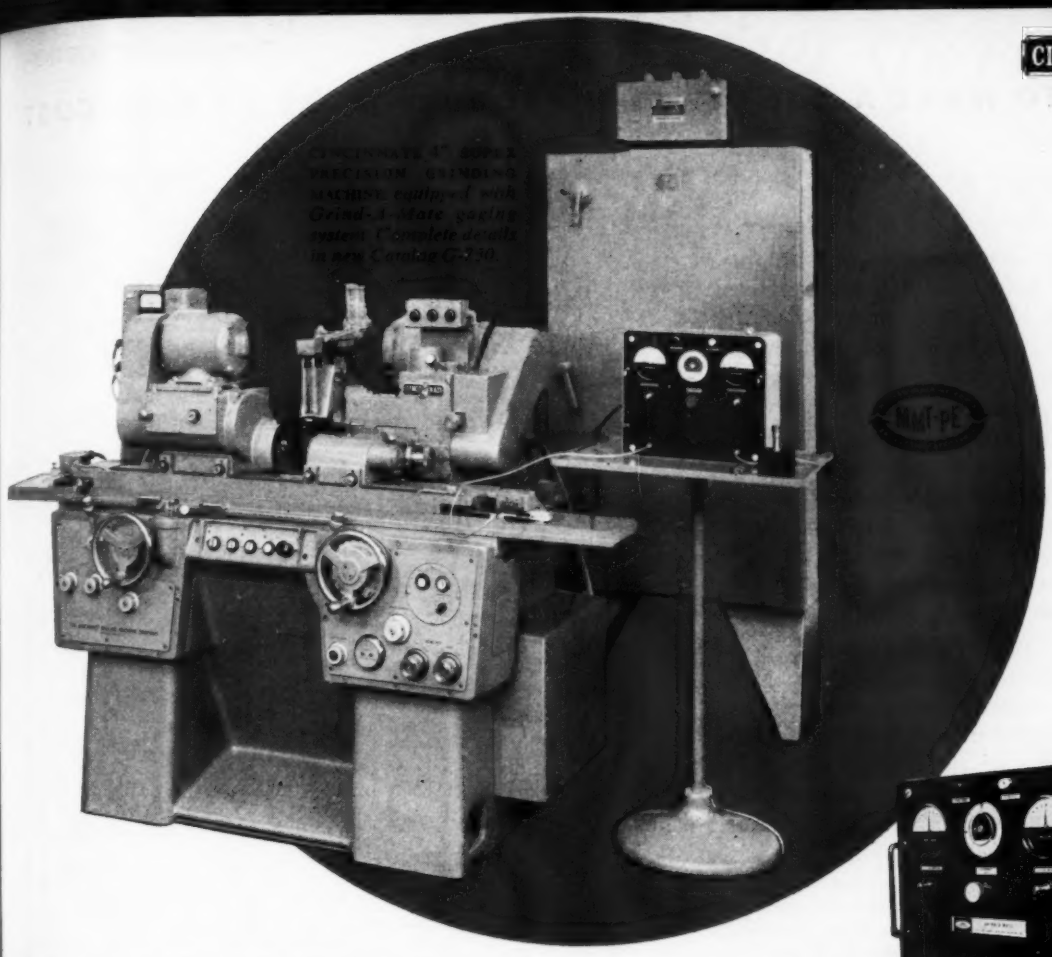
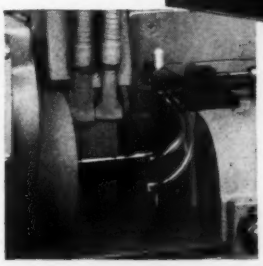




New CINCINNATI 4″ Super Precision Grinder

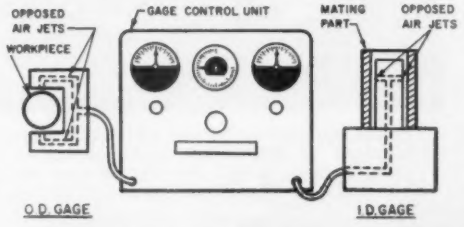
gives you ultra-high accuracy in matched grinding

Here is a machine designed and constructed for just one purpose . . . ultra-precision grinding. The new CINCINNATI 4″ Super Precision Grinder produces size, roundness, straightness and surface finish *within a few millionths of an inch,* on a semi-automatic production basis. This extreme accuracy has many applications for matched-hole grinding of critical parts, such as missile control valves, fuel injector plungers, and a variety of other mating parts.

For maximum stability the new 4″ Super Precision Grinder incorporates heavy duty castings with extra ribbing. All alignments and center heights are held to tolerances approaching the vanishing point. Motors are super balanced, and both cutting fluid and hydraulic tanks are isolated from the machine to eliminate vibration. A special dual rate automatic infeed unit provides rates as low as .0002″ per minute. Cincinnati's Gage-Line unit assures extremely accurate taper adjustment, without trial and error or bothersome calculations; temperature and footstock tension adjustment are regulated with equal precision.

Our Grinding specialists will be glad to provide further details. For specifications write for new Catalog G-730. **Grinding Machine Division, The Cincinnati Milling Machine Co., Cincinnati 9, Ohio.**

AUTOMATIC GRINDING OF MATING PARTS *to desired clearance is completely controlled by exclusive Grind-A-Mate Gaging System. Air jet gages continuously measure both the OD of workpiece (left, above) and ID of mating part; and indicate on a high amplification differential meter (right, above) the variation between the two diameters.*



PRECISION GRINDING MACHINES: CENTERTYPE • CENTERLESS • MICRO-CENTRIC • ROLL • CHUCKING • CENTERLESS LAPPING

CINCINNATI GRINDING MACHINE DIVISION

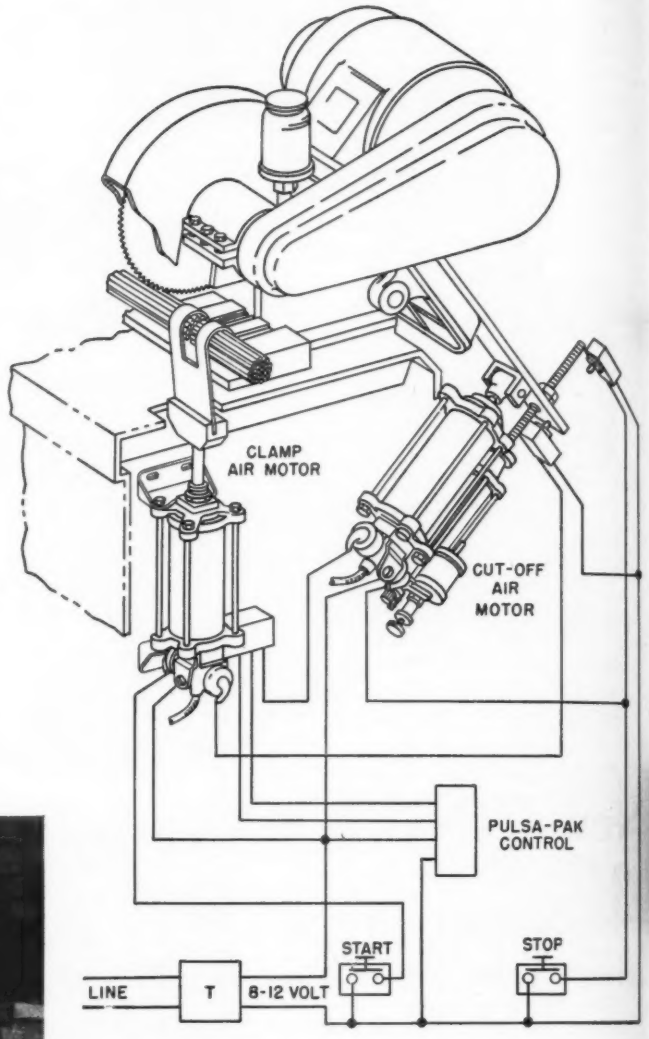
CIRCLE INFORM-A-GRAM KEY NO. 67

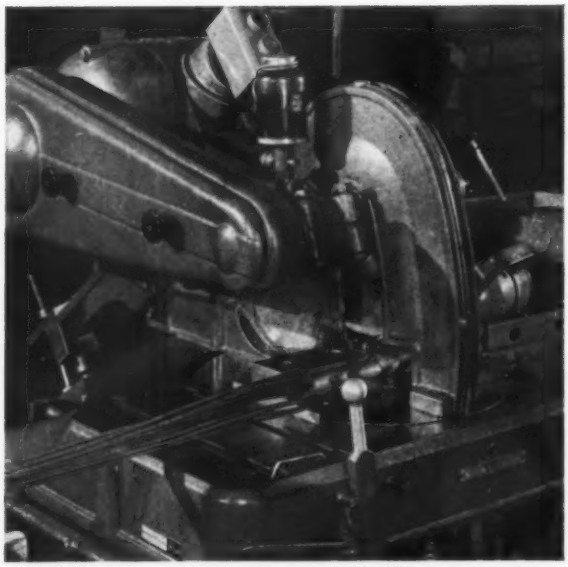
HOW TO MAKE A CUT-OFF SAW PRODUCE MORE AT LESS COST

Shown at the right is a SPOT-A-MATION IDEA used in many plants. Almost invariably it has meant cost savings of 50% or more—has improved product quality, lengthened saw life, lessened worker fatigue.

Two Bellows Air Motors are used. One, hydraulically controlled, feeds the saw through the work. The second clamps the work in position. The two Air Motors are electrically interlocked. The cut-off saw can be made completely automatic by adding a third Air Motor to feed the material.

This is another typical way Bellows Air Motors are used to "Spot Modernize" existing equipment. Almost any hand-fed, or hand-controlled machine can be made to produce more, at less cost, with versatile Bellows "Controlled-Air-Power" Devices.





Typical application of this SPOT-A-MATION IDEA in the plant of Milwaukee Gas Specialties where gas tubing is cut to length. Here costs were cut better than 50% and cost of rejected material reduced 20%.

THIS SPOT-A-MATION IDEA FILE IS YOURS ON REQUEST

Contains drawings, circuit diagrams, equipment list, and full details to enable you to convert existing equipment to lower cost operation. Write for it today. No obligation.

Address Dept. TP-560, The Bellows Co., Akron 9, Ohio.

The Bellows Co.

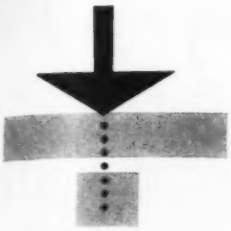
DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION (IBEC)

AKRON 9, OHIO

1284-B

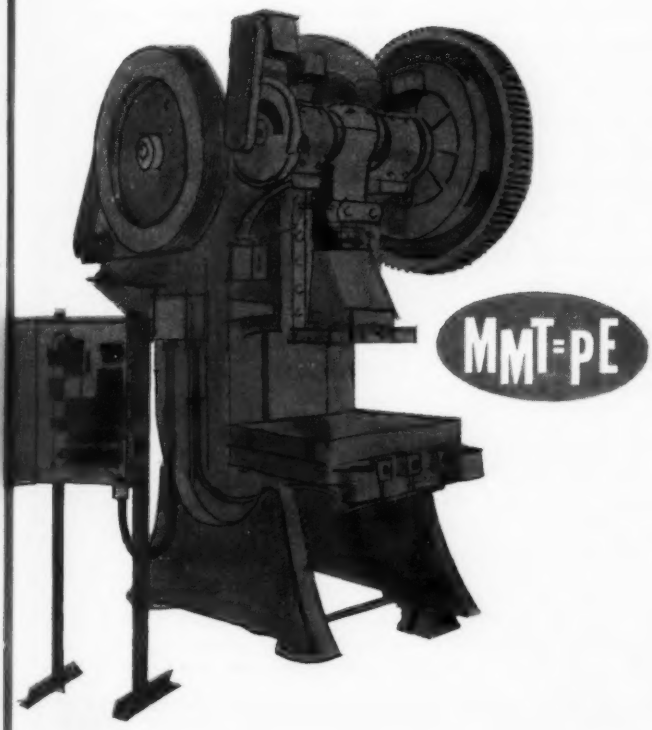
OTHER INDUSTRIAL DIVISIONS OF IBEC: Sinclair-Collins Valve Co., Valvair, Akron, Ohio • V. D. Anderson Co., Cleveland, Ohio

CIRCLE INFORM-A-GRAM KEY NO. 68



Gain higher speeds- lower maintenance- longer press life!

FEDERAL AIR CLUTCH PRESSES



The new Federal friction-type air clutch is designed specifically for presses . . . operates on controlled air pressure . . . uniformly engages a full 360 degrees of friction surface. An air solenoid, regulated by interlocking control circuits, activates the clutch. When diaphragm is expanded, *instant and total contact* is established. Flywheel mounting reduces the mass to be put into motion. Minimum movement and the elimination of drag on the brake assures fast engaging and disengaging at *any speed. Never requires adjustment.* Uniform distribution of torque, elimination of concentrated stresses, overload protection and shock-free engagement mean longer life!

Check the comparison chart below. Feature for feature—dollar for dollar, Federal Air Clutch Presses are your best buy! Write for catalog.

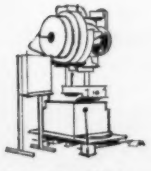
FEATURES	FEDERAL	PRESS A	PRESS B
Fail-safe Control	Yes	No	No
Dual Solenoid Valve	Yes	No	Yes
Air Filter Lubricator Pressure Regulator	Yes	No	No
Meehanite Castings	Yes	Yes	No
Anti Tie-down Push Buttons	Yes	No	Yes
Stranded Wire	Yes	Yes	No
Solderless Connections	Yes	No	No
Emergency Stop	Yes	No	Yes
Top Stop	Yes	No	Yes
Selector Switch	Yes	Yes	No
Guarded Foot Switch	Yes	No	No
Oil-tight Enclosures	Yes	No	Yes

FEDERAL

open-back inclinable

PRESSES

Horizontal Presses


Flying Cutoff Presses

Extruding Presses

Dial Feed Presses

THE FEDERAL PRESS COMPANY of Elkhart, Indiana. Dept. 807

CIRCLE INFORM-A-GRAM KEY NO. 69

Giant Turret Machine Uses 183 Spindles

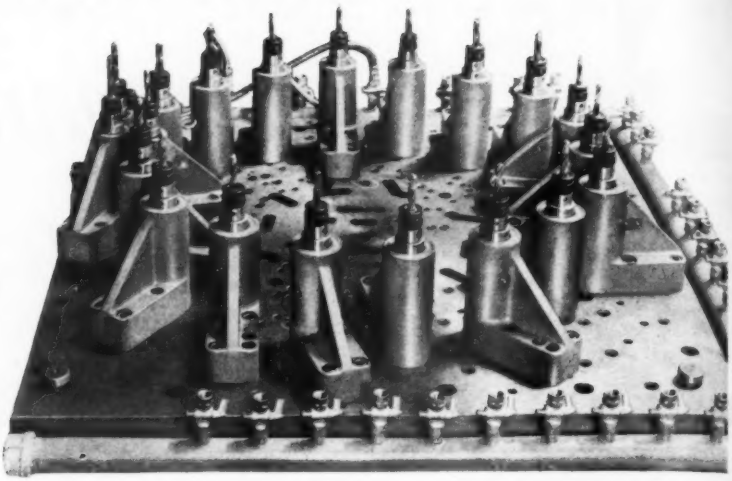


Fig. 1. Special design of spindle plates permits maximum number of hole patterns.

AUTOMATIC, UNITIZED, and bristling with spindles—that's the way to describe Michigan Special Machine Co.'s new giant turret machine. It has 183 interchangeable spindles for drilling, reaming, tapping, boring, chamfering, and spotfacing 13 different sizes of commercial gas meter bodies. What's more, some of the spindles have multiple heads in clusters of three, operated from a single splined take-off. Output is 10 cast iron aluminum meter bodies an hour.

All of the spindles are driven by universal-joint type drives to allow greater interchangeability and positioning. The spindles and spindle plates are pre-bored for position to reduce changeover time and to assure accuracy of all holes. The ball-bearing stub drilling spindles and ball-bearing lead screw type tapping spindles are pre-set on plates (Fig. 1) outside of the machine. Design of the plate patterns permits an infinite number of hole patterns.

Unitized building block construction combines the 183 spindles into an impressive array of production-ready tools. Figure 2 shows this combination of Michigan Special's self-contained units. The 4-station hydraulic index table on the left supports two drill heads and two tap heads. On the right is a 2-station hydraulic index table which supports a drill head and a tap head.

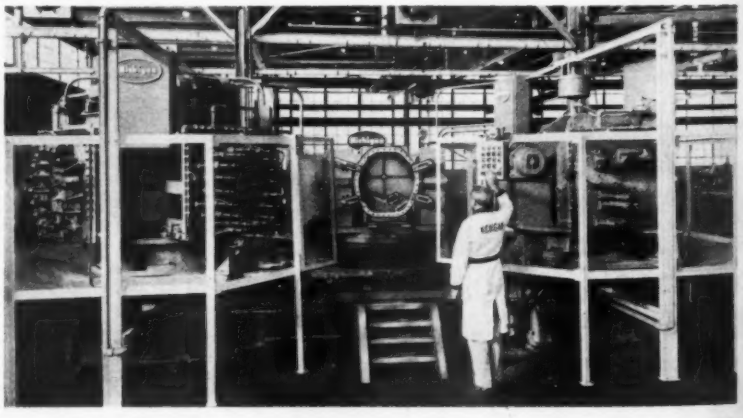
A special horizontal feed unit is mounted between the index tables, and a 3-station hydraulic index table with hydraulically actuated hold-down clamps is mounted on the platen of this unit. The table supports either one of the two single-place workholding fixtures.

There are two major setups for machining the gas meter bodies: one for the side cover face, the second for the top cover face. The part is loaded and hand clamped in the fixture at the front of the center index table. The protective wire screen is closed and locked and the proper cycle for the size, style, and face to be machined is selected.

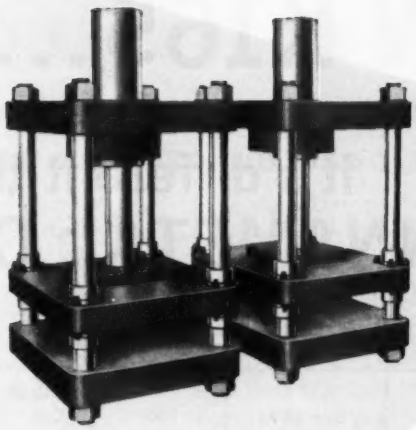
First, the part indexes 90°. The first head on the left side turret then moves into position. Next, the table carrying the part moves into the drills. The part then withdraws far enough to permit indexing of the left side table, which presents another group of drills for repetition of the drilling cycle. Successive indexes of the left side table present the two heads for the tapping operations.

After withdrawing from the second group of taps, the center table indexes 180° and presents the face of the part to the two-position turret on the right. This turret does the drilling, tapping, boring, and chamfering operations in the same manner as the left side turret. The part then withdraws, and is automatically indexed to face the operator for unloading. end

Fig. 2. Part clamped on center index table is first fed into each of the four heads of the indexed turret on the left, then withdrawn and turned 180° for feeding into the two heads on the right side turret.



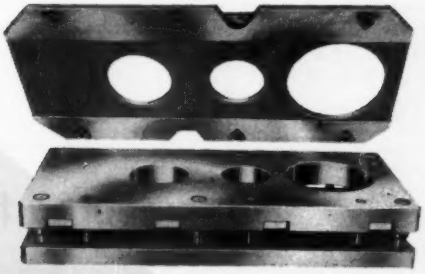
Do you have a special die set problem?



Producto can help you solve it. Special die sets can be large or small—weigh tons or a few pounds; they may be of steel plate, or castings; two-plate or multi-plate.

Often, they can be ordered directly from Producto's catalog. We regularly machine our "catalog specials" to meet your individual requirements. And, when you need a radically different, one-of-a-kind die set—call us. Our 35 years of die set manufacturing experience are yours for the asking.

Just call your nearby Producto distributor, or our manufacturing plants in Bridgeport or Detroit.



DIE SET DIVISION
THE PRODUCTO MACHINE COMPANY
945 Housatonic Avenue, Bridgeport 1, Connecticut

PRODUCTO

DIE SETS & ACCESSORIES · PUNCHES & DIES · TOOLROOM EQUIPMENT

CIRCLE INFORM-A-GRAM KEY NO. 71

NEW K165...

It's different than any other KENNAMETAL* CUTTING GRADE

TYPICAL PERFORMANCE OF KENNAMETAL K165

Work Material	Operation	Tool	Depth of Cut	Speed sfm	Feed ipr	Performance
Arma Steel 88M, 32 RC	Finish facing 50 rms max. finish	KSBL-16C SPG-422	.021"	775	.0024	77 pieces per index with 20-30 rms finish. Best performance other tool material: 20 pieces per index with 40-60 rms finish.
AISI 308 Stainless Steel Tubing	Finish turn tracer lathe	KTGR-20C with TPG-433	.020" to .093"	950	.010	Negligible tool wear. 50 rms finish. .0001" loss of size in 41" cut. Old tool material: .030" flank wear, unacceptable finish, and .005" loss of size.
Cast Iron	Finish turning	Special TNG-321	.020"	1260	.009	Best performance of any other cutting materials evaluated.
M2 HSS Forging	Finish turning	KSFR-16 SNG-422	.100"	585	.016	11 pieces produced with less than .005" wear land. Previous tool material: 6 pieces at considerably lower machining conditions.
304 Stainless Steel	Precision boring	Precision boring tools	.0075"	1500	.003	6 holes, 5" deep, resulted in only .0002" loss of size and a surface finish of 10 rms.
Tricent Cylinder Case, 44.3" dia. x 23" long, 46 RC	Finish turn	KTDR-16C TPG-322	.005"	480	.007	40-60 rms finish. No measurable taper or tool wear. Previous tool material: extreme difficulty in obtaining 125 rms finish; unacceptable taper required additional passes and severe steps.

Engineered for the new era in machining

- For high velocity precision machining.
- Exceptional high hardness-strength for machining high temperature alloys of low machinability.
- Possesses greater combined crater and edge-wear resistance than conventional tungsten carbide cutting tool materials.
- Produces surface finishes as low as 12 rms and better . . . frequently eliminates expensive grinding operations.
- Maintains greater accuracy . . . reduces "loss of size" due to greater resistance to edge wear.

now available in limited number of KENDEX* INSERTS

KENNAMETAL *Inc.*

LATROBE, PENNSYLVANIA

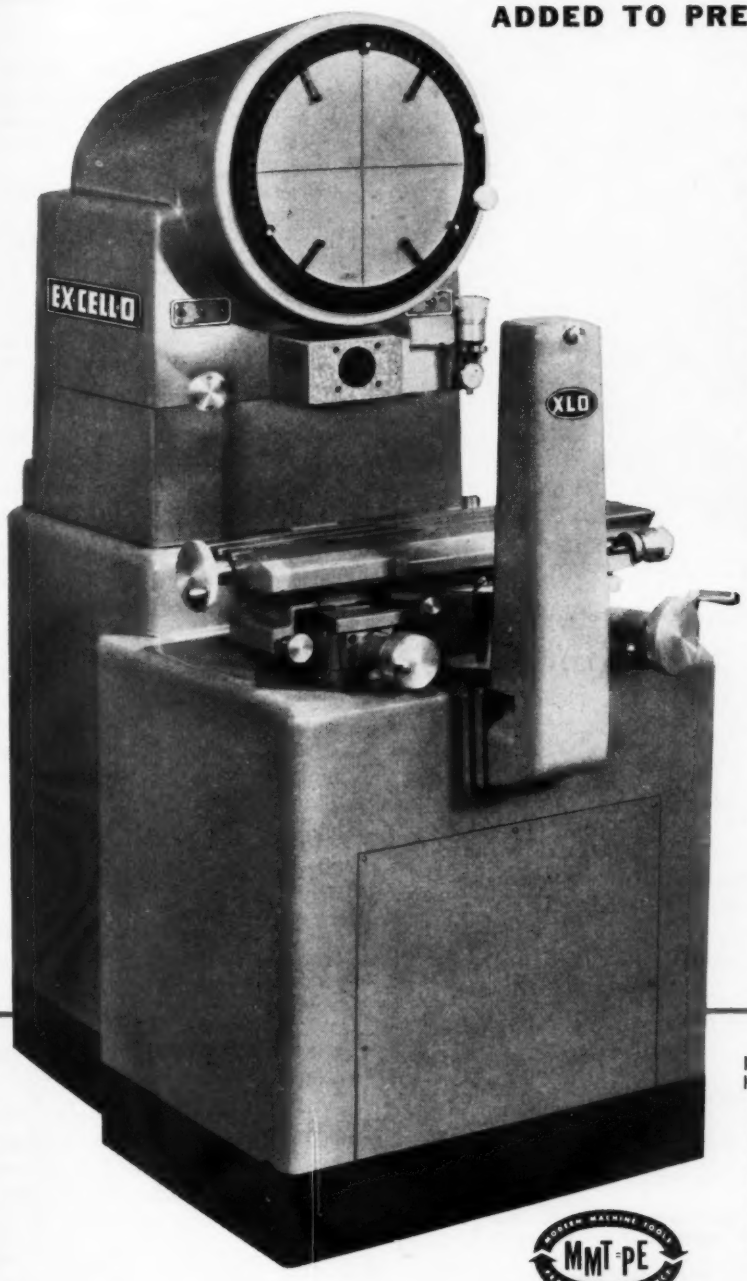
*Trademark

97187

CIRCLE INFORM-A-GRAM KEY NO. 72

NOW — CONTOUR PROJECTORS FROM EX-CELL-O!

FORMER KODAK® OPTICAL PROJECTORS ADDED TO PRECISION GAGING LINE



Precision Contour Projectors, formerly manufactured by Eastman Kodak Company, have been added to an expanded line of gaging and inspection equipment from Ex-Cell-O. They are sold and serviced by Ex-Cell-O's subsidiary, Optical Gaging Products, Inc.*

Ex-Cell-O Contour Projectors are available in six table and console models for measuring and inspecting parts ranging in size from the smallest watch springs to huge breech blocks, with accuracy to .0001".

Features: Kodak Ektar® highest quality optics; finger-tip controls; vertical or horizontal projection; wide selection of lenses; maximum staging space and table travel; screen sizes from 8" to 30"; and rugged, precision construction.

Contact your Optical Gaging Products, Inc. Representative.

®Kodak and Ektar are registered trademarks of Eastman Kodak Co.

*26 Forbes Street, Rochester 11, N. Y.

Illustrated Model 14-5 is designed for large, heavy parts. Standard features include:

- 14" screen with full-width brilliance.
- Extra-large, 26" x 8" heavy-duty work table.
- Built-in helix table.
- Full 17½" throat clearance.
- Six magnifications from 10X to 100X.
- Protractor ring for measuring image angles.
- Vertical and horizontal measuring attachments, each with dial indicator and .0001" micrometer.

MMT-PE MODERN MACHINE TOOLS PRODUCTION EFFICIENCY

EX-CELL-O FOR PRECISION

Machinery Division

EX-CELL-O PRECISION PRODUCTS INCLUDE: MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • TORQUE ACTUATORS • GAGES AND GAGING EQUIPMENT • GRANITE SURFACE PLATES • ATOMIC ENERGY EQUIPMENT • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

60-50

CIRCLE INFORM-A-GRAM KEY NO. 73

interchangeable with all standard JIC cylinders

With the introduction of the ALL NEW T-J Squair Head, Tomkins-Johnson now offers industry the most complete design range of air and hydraulic cylinders. Presently available in bore diameters from 1-½ to 8 inches, the T-J Squair Head is an interchangeable cylinder which produces maximum force and efficiency, with minimum pressures . . . and is also adaptable to the use of low pressure oil as the working medium. Write today to The Tomkins-Johnson Co., Jackson, Michigan, for Bulletin #SQ 10-58 and complete details.

CHECK THESE 10 POINTS OF T-J SUPERIORITY

1. One Piece Piston
2. Hard Chrome Cylinder Bore and Piston Rods
3. High Tensile Steel Tie-Rods
4. Cushion Adjusting Screw, Externally Adjustable
5. New Super-Cushion for air, or Self-Aligning Master Seal for oil (T-J Patents)
6. Solid Steel Heads and Mounting Plates Standard all Models
7. Port Design Allows Minimum Pressure Drop on Inlet or Outlet
8. Chevron Type, Self-Adjusting Rod Packing
9. Piloted Packing Gland—Absolute Alignment
10. Piston Rod, Extra Strong—Polished and Chrome Plated for Efficiency and Protection

T-J TOMKINS-JOHNSON
RIVITORS . . . AIR AND HYDRAULIC CYLINDERS . . . CUTTERS . . . CLINCHORS

CIRCLE INFORM-A-GRAM KEY NO. 74

L. G. Johnson was recently named northern California district sales manager by The Cleveland Cap Screw Co.

Recently appointed assistant to the general sales manager of the Buhr Machine Tool Co. is **Robert L. Deneau.**

Taking over as director of sales for Beaver Tool & Engineering Corp. is **Bernt T. Nordfjord,** with **Roy H. Flones** assisting.

Herman Schroll is the newly appointed sales manager for the Die Supply Division of E. W. Bliss Co. His headquarters are in Cleveland.

Latrobe Steel Co. has named **Thomas J. Bridgeman** assistant sales manager for the Detroit district.

The Whitman & Barnes Division of the United-Greenfield Corp. recently announced the appointment of **R. J. Conroy** as assistant sales manager, with headquarters in Plymouth, Mich.

New Michigan sales representative for Acheson Colloids Co. is **Henry J. Lang.**

Newly appointed sales manager of Meier Brass & Aluminum Co. is **Edward F. McWhirter.**

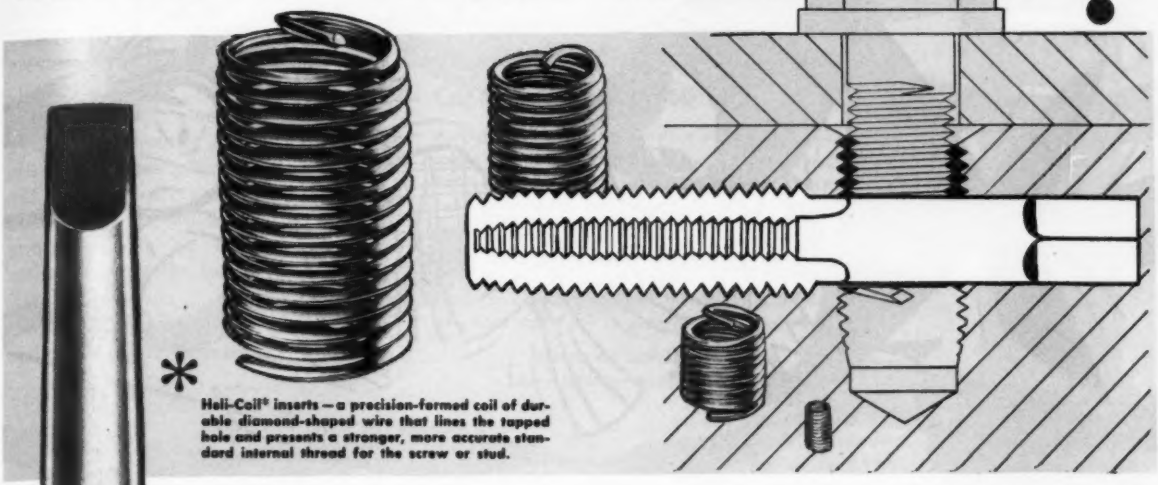
Commander Mfg. Co. has made known the appointment of **Roy Groth** as sales manager.

New general sales manager of The Weldon Tool Co. is **S. E. Smith, Jr.,** succeeding **J. H. Devlin,** vice president in charge of sales, who retired.

S. P. Gaston has taken over as assistant sales manager, Cold Finished Products, Vulcan-Kidd Steel Division, H. K. Porter Co., Inc.

Kenneth H. Carlson has been appointed by Firth Sterling Inc. as manager of technical services. He will be technical and metallurgical advisor to users of high purity metals.

TAPPING FOR HELI-COIL* INSERTS ...?



Heli-Coil* inserts — a precision-formed coil of durable diamond-shaped wire that lines the tapped hole and presents a stronger, more accurate standard internal thread for the screw or stud.

...Here's What MOHAWK STANDARD SUBLAND DRILLS can do to save you TIME, TOOLS and $ $

Mohawk Subland Drill-Chamfer "Standards" will streamline those all-important hole drilling operations prior to tapping, by combining both drilling and chamfering into *one* simple, simultaneous one-tool application.

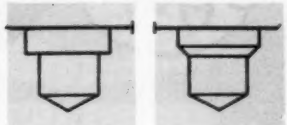
Why chamfer? Because clean, concentric chamfered holes speed tapping, increase tap life and insert accuracy, eliminate breakage, burring or flaking—and lower drilling, tapping and scrap costs.

Mohawk "Standards" are faster and economical to use. They outlast *ordinary* tools, yet remain accurate through regrinds right down to the shank. Better yet, they are available—everywhere!

STANDARD SUBLANDS are stocked in all practical sizes and combinations in 3 step lengths, 3 shank styles.

Short Medium Long

REMEMBER, TOO... Mohawk Standard Subland Drills are also immediately available in Drill-Counterbore and Drill-Drill Types. All practical sizes, step lengths and shank styles.



Subland Drill-Counterbore for Socket Head Cap Screws

Subland Drill-Drill for Tap Drill and Body Clearance

Mohawk TOOLS, Inc.
Montpelier, Ohio

world's largest producer of Subland Drills

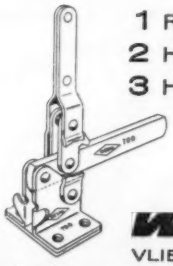
*REG. U. S. PAT. OFFICE

CIRCLE INFORM-A-GRAM KEY NO. 75

There's a WESPO clamp or plier for every clamping job!

80 models and sizes...

made better three ways to give more positive holding, last longer!



1 Reamed holes
2 Hardened serrated bushings
3 High tensile strength rivets

send for free catalogs describing Wespo clamps and fixture details

WESPO DIVISION
VLIER ENGINEERING CORPORATION
Formerly West Point Manufacturing Company
26935 W. Seven Mile Road • Detroit 19, Michigan

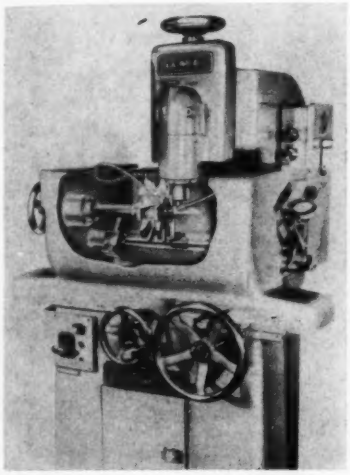
CIRCLE INFORM-A-GRAM KEY NO. 76

Union Twist Imports Cutter Grinder Line

A line of tool cutter grinders, to be shown at the ASTME Exhibit by Union Twist Drill Co., was recently previewed at their Athol, Mass., plant.

The five basic machines—Model 1 cutter and reamer grinder, Model 2 form cutter grinder, Models 3 and 5 tangent-arc profile grinders, and Model 4 multi-point drill grinder — will be manufactured and sold under the name of UTD's Hartex Div'n.

All of the machines except the multi-point drill grinder are being



built in West Berlin, Germany, by the Hartex Div'n of R. Stock & Co., a subsidiary of UTD.

All parts are interchangeable and replacement parts are readily available, says UTD. Feeds are arranged in decimal inch increments, and screws and bolts used in assembly, as well as feed and actuating screws, have standard U. S. threads and heads. Literature is available from the company, or circle Inform-A-Gram No. D1.

Shop Talk

Definitions:

Engineering Change—Method of keeping the issue confused until the mistake can be rectified.

Feed Back—The return of bum dope.

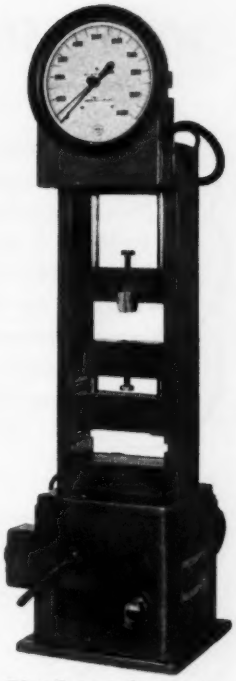
Pilot Run—Planned confusion.

Tensile Testers

• Motorized • Bench-Mounted
• Easy-to-Operate • Low Cost
Capacities from 1,000 to 20,000 lbs.

Available in two general sizes that occupy minimum space and provide consistently accurate and dependable results. Simple, easy-to-use controls are conveniently located on front of base. Jaws are quickly changed to accommodate specimens of different sizes. Operation is hydraulic; powered by 1/6-hp. 110-v motor. Load gage is protected from specimen-fracture shock by rubber mount. Twin load gages and floor stand are available as optional equipment.

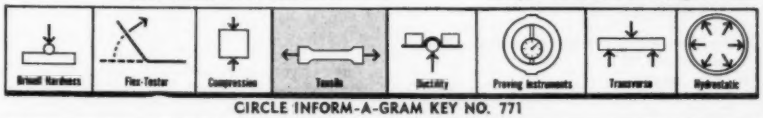
Write or call if you have any special testing problem



These machines are designed to also perform compression tests.

Steel City Testing Machines Inc.
8815 Lyndon Ave., Detroit 38, Mich.

Distributors in most major metalworking areas



CIRCLE INFORM-A-GRAM KEY NO. 771

Aluminum-Magnesium Alloys Are Toughened

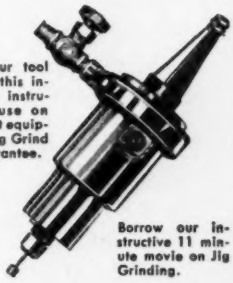
A new tempering process that increases both strength and reliability of the strongest aluminum-magnesium alloys has been announced by Aluminum Co. of America.

The process makes possible two new tempers—H323 and H343. Both are said to assure maximum resistance to stress corrosion for sheet in alloys 5456 and 5083, widely used in applications ranging from boat hulls to missiles.

"High properties previously were obtained in 5083 sheet by cold working the metal to the H32 and H34 tempers," according to R. A. Sweet, Alcoa's manager of sheet and plate sales. "The amount of work imposed increased the alloy's susceptibility to stress corrosion. A similar situation existed with alloy 5456, though to a much lesser degree . . ."

The new H323 temper has boosted alloy 5456's minimum tensile strength 4% over any previously available. This alloy has the highest strength composition in the aluminum-magnesium series.

HOLES JIG GROUND with *Vulcanaire*



Provide your tool room with this inexpensive instrument for use on your present equipment and Jig Grind with a guarantee.

Borrow our instructive 11 minute movie on Jig Grinding.

Your Tool Room in Dayton
Designers and Builders
Special Tools — Dies — Machines
Request Quotation

VULCAN tools
VULCAN TOOL CO.
734 LORAIN AVENUE
DAYTON 10, OHIO

CIRCLE INFORM-A-GRAM KEY NO. 772

JOHANSSON GAGING EQUIPMENT

Assures You Precision to the Finest Degree to Meet Your Requirements —Backed by the Name Supreme in the World of Measurement

GAGE BLOCKS

(JOHANSSON) and accessories. Short deliveries. Inspection and reconditioning service available at our plant.

INTERNAL INDICATORS

(for inside measurements .155 to 24 inches). Scale range plus or minus .001 graduated to .0001 and minus .020 graduated to .0001.

MIKROKATOR

(Amplifier—for outside measurements) Graduations .0001 to .000001 or .01M to .0002M.

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Micrometers, Snap Gages, Extensometers, Dynamometers, Hardness Testers, Surface Finish Indicators, Interferometers, Plugs, Rings and Special Gages.

MULTIMI

Multiple Interference Microscope

The Multimi is an instrument for both scientific and practical measurements through which the possibility has been given to everyone to make use of the great advantages of the interference methods. The accuracy of the Multimi is as high as .04 micro inches, which means an accuracy of about the same value as the atomic dimensions. The fringes are here replaced by what can be classified as lines which constitute real profile curves and contours, exactly reproducing surface shapes of different kinds. The instrument is adapted for photographing the interferogram by a miniature camera. Low reflecting, normal reflecting and high reflecting interference plates are available. It is highly recommended for the following: Surface finish measurements . . . surface finish on quartz plates . . . thickness of films and coatings . . . thermal and mechanical deformations . . . cell research, etc.

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A DIVISION OF SWEDISH GAGE CO.

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CIRCLE INFORM-A-GRAM KEY NO. 781

America's largest selection of economically priced PRESS ROOM EQUIPMENT

Durant

TOOL COMPANY
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DOUBLE STOCK REELS from $395.00

Motor Driven **Stock Straighteners,** 13 Models from **$682.**

Write for new, free catalog detailing a complete selection of Die Set Pullers, Roll Feeds, Punch Holders, Wire Straighteners, and Standard Stock Straigheners . . . Over 100 necessary pieces of equipment for the modern press room.

Our nearby representatives will be pleased to be of service to you without obligation.

STOCK OILERS, 5 Models from $41.80

Motor Driven **Scrap Choppers,** 4 Models from **$235.**

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Toughest, hardest, strongest . . . none finer at any price!

It pays to specify

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DRILLS
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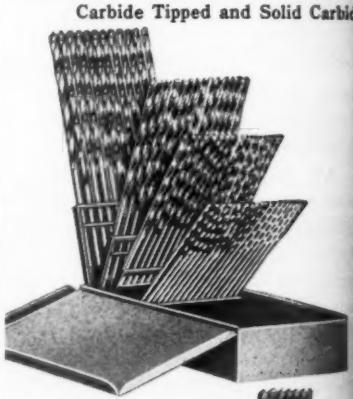
Premium Quality High Speed Steel
Carbide Tipped and Solid Carbide



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Standard Fractional, Wire and Letter series drills conveniently packed in folding indexed cases.

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Consist of uniformly hardened high speed steel drill and reamer blanks—precision ground to new close tolerances.

Call your local distributor today—or write Ace direct for latest catalog and price information.

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Adrian, Michigan

ORIGINATORS OF "GROUND-FROM-THE-SOLID" DRILLS

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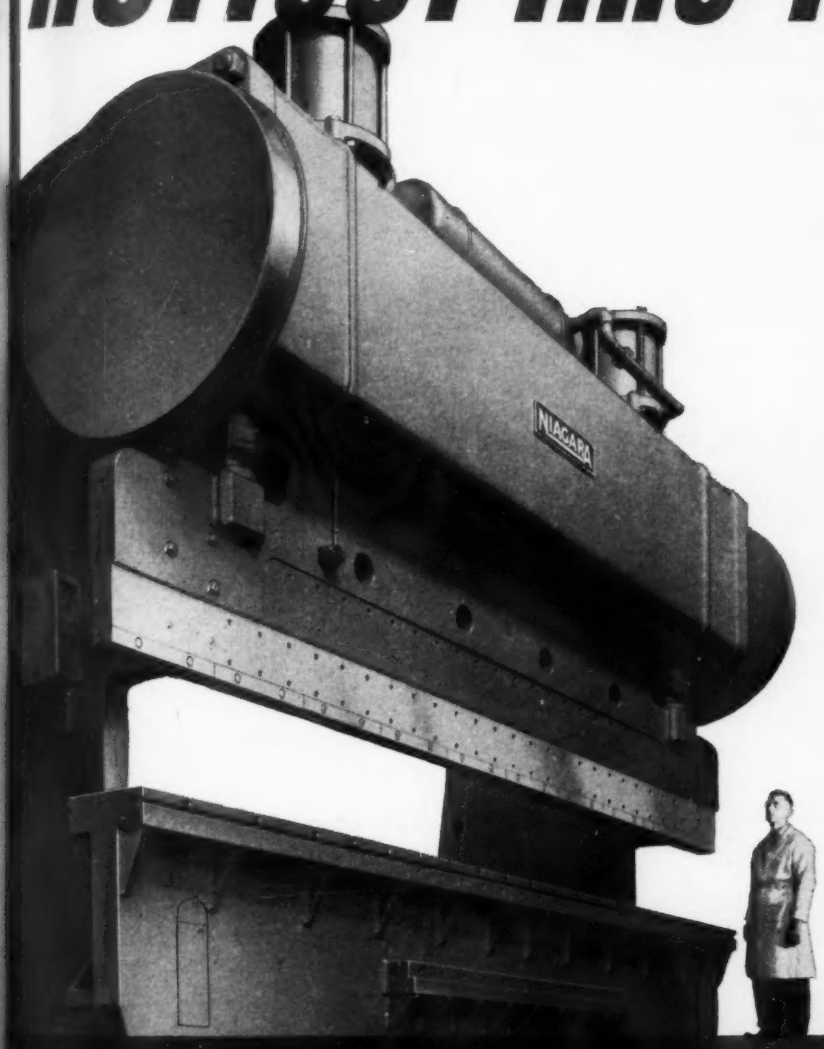
NIAGARA PRESS BRAKES

MMT-PE
MODERN MACHINE TOOLS
PRODUCTION EFFICIENCY

hottest line today



..way out front in production-boosting, cost-cutting features... highest dollar value of all

Hottest line in the industry, more Niagara Press Brakes are being bought today than ever before.

What's behind it? **Performance!** Downright, measurable, press brake performance! High hourly output with minimum operator effort is setting new work standards in plant after plant.

How about you? Want to sail through your schedules at record-breaking speed... cut your operating and maintenance costs to the bone... hold your capital investment to a **practical minimum... then Niagara is the press brake for you.**

Talk it over with a Niagara sales engineer. He has the facts to give you a fair comparison **...on every point.**

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77 sizes to choose from

- 15-1500 tons
- Power or Manual Clutch
- Smooth, micro-inching ram
- Wear resistant, non-metallic ways
- Gearing enclosed in sealed oil bath

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Distributors in principal U.S. cities and major foreign countries

CLAUSING COLCHESTER GEARED-HEAD LATHES

Clausing-Colchester 13″, 15″ and 17″ lathes are by long odds the greatest values in lathe history. Note the following outstanding superiorities and rock-bottom prices:

● **WORLD'S FINEST MACHINE TOOL BEARINGS** . . . Tapered roller bearings with oil-flow lubrication. Just look at the size:

LATHE	17″	15″	13″
FRONT SPINDLE BEARING O. D.	7½″	5½″	4″

● **CIRCULAR ACCURACY OF EVERY LATHE IS GUARANTEED TO BE WITHIN .0001″!**

● **BIG SPINDLES WITH LARGER THRU-HOLE CAPACITY:**

LATHE	17″	15″	13″
THRU-HOLE	3″	2″	1½″
NOSE TAPER KEY DRIVE	L-2	L-1	L-0

SEE US AT BOOTH 1931
A.S.T.E. SHOW, DETROIT.

● **INDUCTION-HARDENED BED WAYS** . . . Standard equipment at no extra cost!

● **ALL-GEARED HEADSTOCK** . . . Gears are induction hardened.

● **OIL BATH LUBRICATED HEADSTOCK and QUICK CHANGE GEAR BOX** . . . both totally enclosed.

● **SEPARATE FEED ROD FOR POWER FEEDS** . . . Lead screw is used for thread cutting only.

● **LOWEST PRICES** . . . The Clausing-Colchester is the biggest lathe value you can find anywhere! The 13″ straight bed model starts at $2302; 15″—$3221; 17″—$5070. Gap bed models are available in all three sizes. *Prices include 2-speed motor and American electricals.*

Get all the facts. Compare Clausing-Colchester with any other lathes of comparable size . . . feature for feature, dollar for dollar. Prove to yourself that Clausing-Colchesters are truly the "Greatest Values in Lathe History" . . . *the* lathes for *your* shop!

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CLAUSING DIVISION
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Q. C. Requires Gages to Suit the Job-

that's why FEDERAL offers such a variety of Gages!

Inside and Outside CALIPER GAGES

Specially shaped arms of various lengths can be designed to reach inaccessible spots or get around obstructions.

Standard Model 149P-20 1" to 3"

Standard Model 49P-1 0" to 3"

Just *any* gage is not good enough. Some dimensions require a higher degree of accuracy than others. And some dimensions cannot be reached directly. Still others need ranges or adjustments to give greater gage capacity.

It's easy to check a dimension with a Federal Gage — and it's the quickest and least expensive way. Just call Federal and get the *right* gage for your job.

FEDERAL PRODUCTS CORPORATION
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HOLE LOCATION GAGES

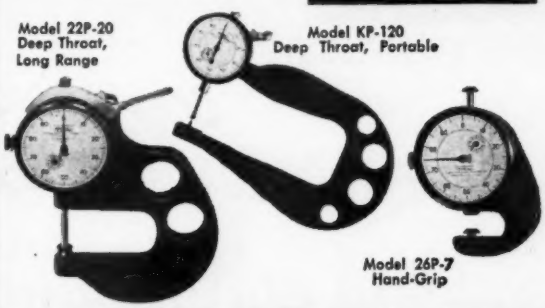
Series 205 Gages accurately check hole location and concentricity. Also adaptable to applications involving hole and surface relationships.

Typical Series 205 Gage (12 Basic Models)

Squareness and location of holes in three mating parts of pump are checked to determine alignment within .0001".

ALL TYPES OF THICKNESS GAGES

Many styles and sizes, for portable and bench use.



Model 22P-20 Deep Throat, Long Range

Model KP-120 Deep Throat, Portable

Model 26P-7 Hand-Grip

BENCH TYPE THICKNESS GAGES and SMALL COMPARATORS

Model 57B-1 Long 1" Range

Model 691B Deep throat. Weight, for compressible materials, assures uniform measuring pressure.

Model 35B-8 Adjustable Table

OVER 10 TYPES OF COMPARATORS

Model 130B-9 Electronic Comparator, Ball Bearing. Detects one millionth.

Model 136 I.D. — O.D. Electronic Master Comparator Detects one millionth.

Whatever You Need in Gages . . .

Ask **FEDERAL** *First*

MANY OTHER TYPES

Send for Catalog showing most complete line of Dial Indicator Gages.

GAGES CAN BE SPECIALLY MODIFIED TO

CIRCLE INFORM-A-GRAM KEY NO. 81

NOW FOR THE FIRST TIME!

REAL INTERCHANGEABILITY IN UNITIZED TOOLING

NEW UNIPUNCH "AJ" Series provides not only interchangeability with UNIPUNCH Series "A" . . . but also WITH UNITS and PARTS of OTHER LEADING MANUFACTURERS!

In keeping with the UNIPUNCH Series "A" Hole Punching and Notching Units this new UNIPUNCH "AJ" Series has the popular "standard" 8⅜" shut height, 3½" die height and the same maximum capacity of ¼" thick mild steel permitting all these Units to be used in the same setups.

All-steel cast holders produce longer life by combining higher tensile strength and longer wear plus greater bearing surface for punch guides than previously available in this type of holder.

USING PEDESTAL DIES Pedestal Die design is ideal for punching holes in angles, extrusions, channels and formed parts with lips or flanges. Slug chutes in these Pedestal Dies may be directed to prevent piling up of slugs—an important feature in making setups for punching a cluster of round or shaped holes.

USING DIE ADAPTERS UNIPUNCH Type "AJ" Hole Punching Units with Die Adapters provide inexpensive Die Button replacement plus quick, easy interchangeability of standard low-cost die buttons—same as used in UNIPUNCH Type "A" and "B" Hole Punching Units.

WRITE FOR ▶ CATALOG AJ

UNIPUNCH®

PUNCH PRODUCTS Corporation

374 BABCOCK STREET, BUFFALO 6, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 821

With heavy duty, rubber tired, ball bearing wheels and one piece fold-down handle, the Wells Model 49A is a metal cutting band saw that's REALLY MOBILE . . . and VERSATILE. Use the 49A as a horizontal cut-off machine (capacity 3½" x 6") or swing the head to vertical position . . . it's an upright band saw.

The optional wheel and handle unit, available for new machines and those already in service, is a tremendous time and labor saver. Ask your local Wells Distributor for details . . . or write for Bulletin 253-H.

Wells

The Pioneers of Horizontal

METAL CUTTING BAND SAWS

1940 Cedar St., Three Rivers, Mich.

CIRCLE INFORM-A-GRAM KEY NO. 822

Stay Sharper Longer

There's no better "insurance" against costly, premature dulling of your high speed production tools than reliable Sentry hardening. Sentry's unique Diamond Block provides a truly neutral atmosphere that permits heat treating for maximum hardness without danger of scale or decarburization . . . keeps your production tools sharper longer.

Like a free demonstration? Send us your sample high speed steel tool and we'll Sentry harden it for you free of charge.

Sentry ELECTRIC FURNACES

Request Catalog J-9. Write THE SENTRY CO., FOXBORO, MASS.

CIRCLE INFORM-A-GRAM KEY NO. 823

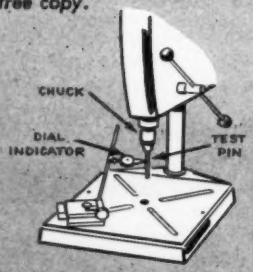
A
SHOP SUGGESTION
FROM
SUPREME

HOW TO TEST A CHUCK
FOR ACCURACY...

INDUSTRIAL DISTRIBUTORS
THE RIGHT HAND OF PRODUCTION

For fastest, most dependable service . . . order from your LOCAL Distributor

Supreme publishes an Engineering Catalog that gives exact information on testing a chuck for accuracy. This catalog defines and guarantees each Supreme Chuck's runout limits. *Write for your free copy.*



In the meantime, you can make an accuracy test by this method: Fit a hardened test pin into the chuck. Clamp a dial indicator to the machine so that its point touches the test pin an inch or more below the chuck. If runout is indicated, remove the chuck and repeat test on the arbor or spindle to determine the offending part.

Dirt or chips in the chuck arbor hole can cause runout; so can bent spindles or loose bearings. *Look for the real cause.*

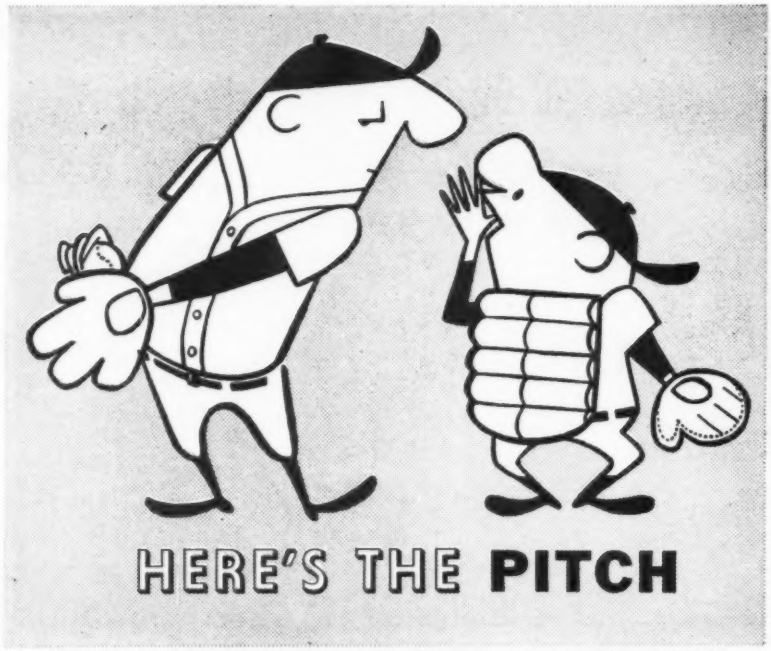
DIV. OF A·S·R PRODUCTS CORP.

Tool room accuracy for production line use

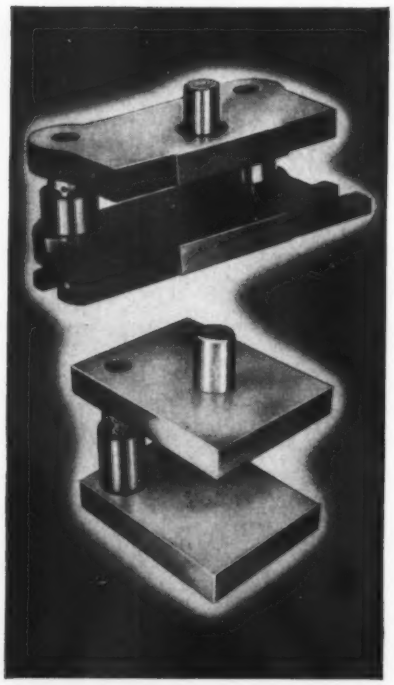
Supreme BRAND Chucks

SUPREME PRODUCTS CORPORATION
2222 SOUTH CALUMET AVENUE · CHICAGO 16, ILLINOIS

CIRCLE INFORM-A-GRAM KEY NO. 83



ONLY LEMPCO DIE SETS OFFER YOU "MINIMUM MAINTENANCE" OPERATION



Operating on Ball Bearing Bushings, with Aluminum Alloy Retainers, Lempco Die Sets deliver millions of strokes, retaining phenomenal precision of alignment, requiring only an occasional dab of grease for lubrication.

NO OTHER DIE SETS HAVE LEMPCO FEATURES!

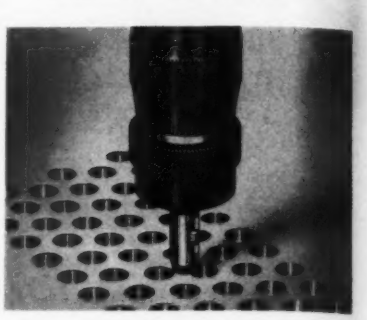
Better look at those Lempco "M" and "L" style die sets, too; they're *all-steel* yet sell for the price of cast iron.

Write today for Catalog and Price Lists.

LEMPCO INDUSTRIAL, INC.
DUNHAM RD., BEDFORD, OHIO
WHERE QUALITY CONTROLS

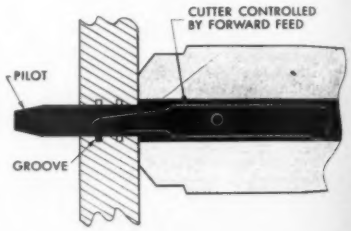
CIRCLE INFORM-A-GRAM KEY NO. 84

Versatile Tool Cuts Grooved Hole Costs



Grooved locating holes in heat exchanger tube sheets are produced with a special cost-saving tool at Ross Heat Exchanger Co.

The spring - loaded Bak-Sink tool, made by Cogsdill Tool Products, Inc., is mounted in a spindle of a programmed drilling machine which positions the tool. As the tool enters the hole, the cutting blade remains inside a pilot arbor. When a ball bearing rotary collar on the tool seats against the work, further forward feed forces the cutter out of the pilot arbor. On the reverse stroke, the blade re-enters the arbor so that it clears the work upon removal.



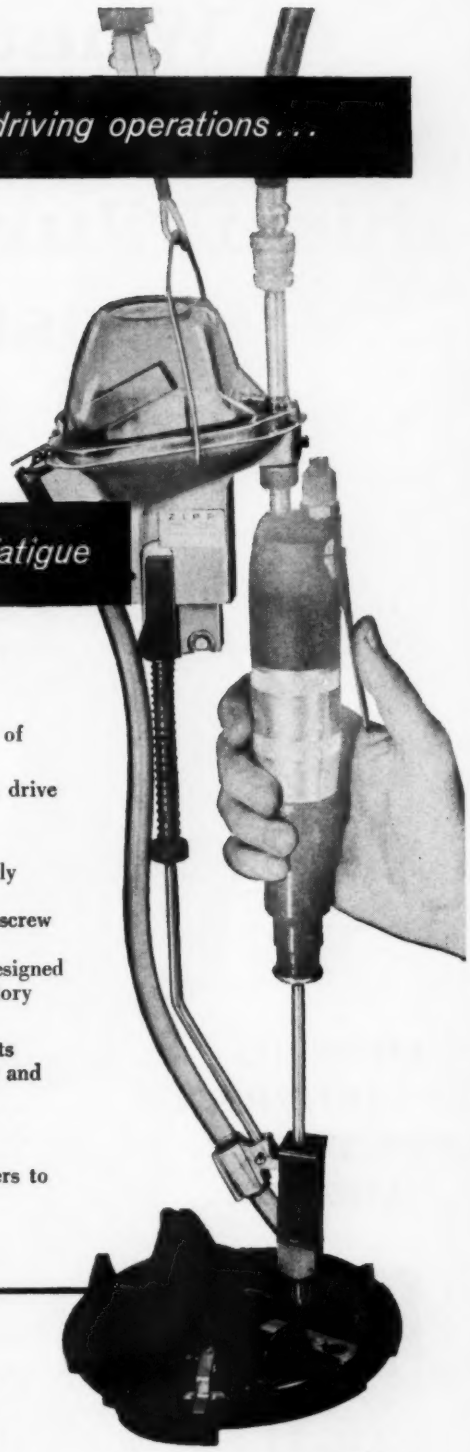
Grooving tool speeds used by Ross approximate reaming speeds for the same material and hole size. Feeds are not critical since an over travel safety within the tool prevents increased depth of cut under excessive feed. Blades are altered to vary the cutting clearance for different materials.

The same basic tool can cut a number of different grooves since blades can be changed in a few minutes without special tools. By exchanging the pilot, Ross can use the same basic tool to groove holes over a wide diameter range. This results in major savings for the company because a separate stock of tools for all diameters and contours is not needed.

new... low cost... for all vertical screw driving operations...

STRIPPIT ZIPP SCREW FEEDERS

save time... cut costs... reduce worker fatigue



save 2 to 25 seconds per piece per station — the new Strippit Zipp Screw Feeder completely eliminates production time lost in manual screw placement.

reduce errors and rejects — worker fatigue with its resulting loss of production efficiency is cut to an absolute minimum.

automatically feeds and drives all type screws — will feed and drive slotted, socket, clutch, hex or Phillips head screws even where clearances are extremely limited.

high efficiency, long run production — these units are particularly effective for the assembly of appliances, electronic and electrical components — and any application requiring continuous vertical screw driving operations.

for "straight type" air screw drivers — Zipp Screw Feeders are designed to fit most makes of "straight type" air screw drivers. They are factory set to fit your present or new equipment.

precision built for accurate operation — the screw holding collets of these machines are precision machined to hold screws accurately and firmly for finding screw holes. There are no delicate mechanisms to get out of order.

low cost, high speed, ease of operation — all contribute to production line economies that enable Strippit Zipp Screw Feeders to pay for themselves in from 30 to 120 days.

WRITE FOR FULL DETAILS — new illustrated literature, complete specifications, price and delivery.

STRIPPIT ZIPP SCREW FEEDERS MOUNT ANYWHERE — on a balancer, fixed position stand, kick press lift table, swing arm tool mount and numerous other ways to meet your individual requirements.

A UNIT OF HOUDAILLE INDUSTRIES INC.

WALES STRIPPIT INC.

212 Buell Road • Akron, New York

In Canada: Strippit Tool & Machine Company, Brampton, Ontario

CIRCLE INFORM-A-GRAM KEY NO. 85

What did this failure cost?

LOOK TO INGERSOLL FOR THE ANSWER

Probably a lot more than should have been gambled! Misapply a cutter, or fail to match it to the machine, and costly failure can be predicted as a certainty.

Only when metal removal programs are carefully analyzed in advance can cutter misapplications be assuredly avoided. That's why many firms rely on Ingersoll for help in arriving at the economical answers to their cutter selection and application questions.

Costs reduction is planned before, not after the work is done. Why not let an Ingersoll representative make a preliminary survey of your upcoming metal removal jobs? It will cost you nothing . . . could lead to important savings. Ask a representative to call, or write for the booklet, "Ways to Reduce the Cost of Chips." Address Dept. H-68.

THE INGERSOLL MILLING MACHINE COMPANY CUTTER DIVISION ROCKFORD, ILLINOIS

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For the deepest draws on the toughest metals

Johnson's 700 WAX-DRAW does every draw in the shop. *Easy to apply* by roller coating, spraying, dipping, etc. Use wet or dry. Blanks can be fed directly into the press or may be pre-coated, dried and palletized. *Easy to remove*, using solvent bath, vapor degreaser, alkaline washer or even hot water alone. *Money saving.* One gallon undiluted covers 2,000 square feet. Four-to-one dilutions produce excellent results. 700 Wax Draw handles multiple draws with only one application even at pressures to 200,000 p.s.i. and temperatures to 450°F.

For further information write: **JOHNSON'S WAX** Racine, Wisconsin, **Dept. TP-5**

CIRCLE INFORM-A-GRAM KEY NO. 87

Built to handle a wide variety of parts—sizes and shapes—the OBE's versatility and rugged design make it a valuable asset in integrating and automating production line operations. Even and continuous flow is provided. Costly and tedious manual operations are eliminated.

Special Features Include:

- High-speed feeding of a wide range of part sizes and shapes.
- Variable discharge track height.
- Variable speed drive to meet machine demands.
- Large storage capacity.
- Automatic feed controls and special orientation devices available. Right- or left-hand discharge to suit your needs.
- Rugged construction — standard components.
- Ease of maintenance—all parts readily available.

Write for complete details on the new RCA Orienting Belt Elevator. Also ask about RCA's full line of automatic feeding equipment.

RCA Tmk(s) ®

RADIO CORPORATION of AMERICA

INDUSTRIAL AND AUTOMATION DIVISION
12601 Arnold Avenue • Detroit 39, Michigan
CIRCLE INFORM-A-GRAM KEY NO. 881

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STRAIGHT

COUNTER BALANCED

REID TOOL ROOM ACCESSORIES, HIGH QUALITY LOW PRICES!

CAST IRON HAND WHEELS

Made in types shown of fine grain cast iron. Rims and handles are ground and polished to high lustre. Many sizes. Top quality. Low prices.

MALLEABLE MACHINE HANDLES

STRAIGHT

In straight, crank and offset types. Many sizes. Strong, Neat. Ready for use.

FREE. Send today for big 88 pg. catalog listing 1800 items needed in your tool room.

REID TOOL SUPPLY COMPANY
MUSKEGON HEIGHTS · MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 882

Rodgers Presses

PRECISION HYDRAULIC POWER

FOR METAL FORMING and DRAWING

From Rodgers "Standard" Line Select your "Custom" Model

Easy as A B C:

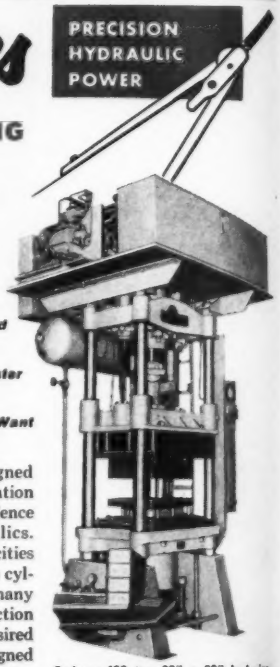
A — *Determine Press Tonnage and Style Press You Need*

B — *Bed and Frame Size Required... Solid or Open Bolster*

C — *Select Pump Unit and Controls To Give Speed You Want*

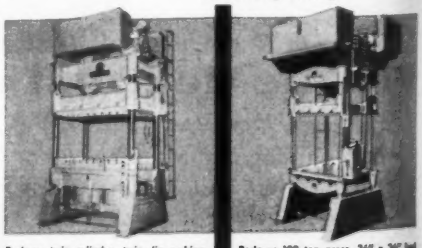
The New Standard line of Rodgers Platen Presses has been designed to greatly simplify press selection. From the basic press styles, one may be selected and combined with varied pumps and controls, automatic, semi-automatic or pressure sensitive, to give the desired speed and performance. This results in savings of "custom" engineering and costs.

Rodgers Presses are designed and built by an organization with over 32 years' experience in high pressure hydraulics. They are available in capacities from 50 to 400 tons, single cylinder or twin cylinders, in many standard models for production or special uses. Where desired custom models will be designed to suit exacting special requirements.


Rodgers 100 ton 30" x 30" bed size with complete one cycle automatic control for deep drawing.

SEND FOR *NEW* CATALOG 337...

This new Rodgers Catalog has complete specifications, tables and data, making it simple to determine the press for the job. Write for your copy without obligation.


Rodgers twin cylinder, twin die cushion 200 ton drawing press with 60" x 48" bed; single cycle automatic.

Rodgers 100 ton press, 36" x 36" bed with single lever pressure sensitive manual control.

RODGERS HYDRAULIC, Inc.
Pioneers in High Pressure Hydraulics Since 1932
7447 WALKER STREET • MINNEAPOLIS 26, MINNESOTA
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GISHOLT

do you have
OIL SEAL TROUBLES?

SUPERFINISH
can solve them!

Here's a typical case where a shaft with ground surfaces was driven at a speed of 1750 r.p.m. The oil seals created enough heat to burn the shaft and stop the motor. To make matters worse, it was found that twice the original speed was necessary. So, the oil seal surfaces were *Superfinished,* and the shaft operated at a speed of 3500 r.p.m. With the *Superfinished* surfaces, no heat was developed at this higher speed. No further trouble was encountered.

Superfinishing is a quick, simple and inexpensive process. Oil seal surfaces are but one of the many applications where it can save you money. Not only can it eliminate trouble, but often it can help you reduce manufacturing costs. Gisholt engineers can advise you regarding its applications.

Write now for new Superfinish Catalog No. 1169-B

GISHOLT MACHINE COMPANY

MASTERLINE GISHOLT SINCE 1887 GISHOLT

Madison 10, Wisconsin

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ASK YOUR GISHOLT REPRESENTATIVE ABOUT GISHOLT FACTORY-REBUILT MACHINES WITH NEW MACHINE GUARANTEE

CIRCLE INFORM-A-GRAM KEY NO. 89

Catalogs and other helpful literature

A New Low Cost Epoxy Tooling and Repair Compound, in either liquid or putty-like form, is introduced in a bulletin. For details, get Bulletin D-10 from Devcon Corp., or Circle Inform-A-Gram No. C1.

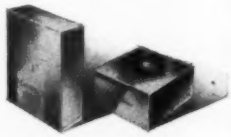
Coolant Filtration Systems for individual machines are described in a bulletin which discusses Hydro-Vac's operation, applications, and capacities. Write Hydromation Filter Co. for your copy, or Circle Inform-A-Gram No. C2

Retainers, Punches, and die buttons are featured in a bulletin that shows the special "split" tapered halves on the die buttons in diagram form. Write Atlantic Special Products Div'n, Atlantic Tool & Die Co. for the bulletin, or Circle Inform-A-Gram No. C3.

Why and How Accumulators are used in a wide variety of hydraulic systems are explained in a new folder. Descriptions and technical data on Parker's range of piston-type accumulators are also included. Get Bulletin 1530B1 from Parker Hydraulics Division, Parker-Hannifin Corp., or Circle Inform-A-Gram No. C4.

Free-Cutting Rods are described in a new 20-page booklet that includes rod and bar tolerances, weights, and specifications. Complete size ranges for Nittany free-cutting brass, leaded naval brass, leaded manganese bronze, and leaded nickel silver alloys are listed. Information on Titan machinability research and quality control, and suggestions for choosing a rod alloy or temper are also given. Get your copy from Titan Metal Mfg. Co., or Circle Inform-A-Gram No. C5.

High Speed Indexing Components, dial feeds, and transfer machines are discussed in a 40-page catalog. Complete load ratings, dimensions, and installation data are presented in tabular form. For Catalog 160, contact Ferguson Machine Corp. of Indiana, or Circle Inform-A-Gram No. C6.



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These are qualities to look for in gage blocks—qualities you'll find finest by far in Ellstrom Chromium Plated Standards. Size, flatness, parallelism unconditionally guaranteed to closer specified millionths than any other blocks you can buy. Made only of time-tested materials fully certified for uniform hardness, absolute metallurgical stability. And gaging surfaces chromium plated by an exclusive Ellstrom process to give you longer wearing millionths, lower gaging costs. Next time you buy gage blocks, be sure you get the very best—be sure to specify

ELLSTROM CHROMIUM PLATED GAGE BLOCKS

MANUFACTURED AND CALIBRATED TO THE INTERNATIONAL INCH—EXACTLY EQUAL TO 25.4 MILLIMETERS

"W" Working Accuracy: +.000006"/−.000000"
Parallelism: .000004" / Flatness: .000004"
"I" Inspection Accuracy: +.000004"/−.000000"
Parallelism: .000003" / Flatness: .000003"
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Above: Ellstrom Rectangular Set No. 85-R. Left: Ellstrom Square Set No. 81-SA, with accessories.

New Catalog contains prices and specifications – send for it today!

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CIRCLE INFORM-A-GRAM KEY NO. 90

FOR PRECISION DRILLING AT RAYTHEON IT'S THE EDLUND MODEL 2G VERTICAL GUN DRILL

THEON'S MISSILE SYSTEMS PLANT, ANDOVER, MASS. USES THE EDLUND MODEL 2G GUN DRILL FOR RATE EFFICIENT DRILLING IN HARD TO WORK METALS.

When your company, like RAYTHEON'S Missile Systems Division Plant, Andover, Mass., requires drilling with extremely close tolerances and precise accuracy, the EDLUND MODEL 2G VERTICAL GUN DRILL is the answer. This machine can cut cost and speed work with the elimination of secondary operations. The EDLUND MODEL 2G VERTICAL GUN DRILL offers precision drilling of odd shaped parts. It is ideal for firms doing intricate work in aircraft, missiles, electronics, or other specialized fields.

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4. This Machine Offers Features to Utilize The Full Potential of the Modern Rotating Carbide Gun Drill.

Send for Free Illustrated Bulletin 2G

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CIRCLE INFORM-A-GRAM KEY NO. 91

Catalogs . .

A Standard Components catalog includes specifications on hand knobs, jig feet, fixture keys, screws, nuts, step blocks, and clamps. Request Catalog 30 from Northwestern Tools, Inc., or Circle Inform-A-Gram No. C7.

"Unitized Broaching Fixtures" covers a variety of self-contained, air-powered broaching fixtures for producing keyways, slots, flats, and small splines. Applications and idea sketches are included in Catalog B60-1 from National Broach & Machine Co., or Circle Inform-A-Gram No. C8.

A Mikrom Comparator bulletin describes this instrument and gives features and specifications of the comparator and the measuring heads. Write Mueller Gages Co. for a copy, or Circle Inform-A-Gram No. C9.

"How to Get Better Countersunk Holes at Lower Cost" discusses four types of countersinks and important factors in countersinking. It recommends the best countersink for portable and machine work and gives regrinding data. Ask The Cleveland Twist Drill Co. for a copy, or Circle Inform-A-Gram No. C10.

A New Pilot Relief Valve, Hydrelief, is introduced in a bulletin that gives applications, specifications, and installation design drawings. Get Catalog File 1561-A11 from Parker-Hannifin Corp., or Circle Inform-A-Gram No. C11.

A New Bonded Dry Film Lubricant, Poxylube, is described in a bulletin which explains its principles and how it's used. Poly Chem, Inc., supplies copies of the bulletin, or Circle Inform-A-Gram No. C12.

For Contour Duplication, drill jig, and pattern work, use one of the 25 epoxy based plastic products outlined in a bulletin from Ren Plastics, Inc., or Circle Inform-A-Gram No. C13.

A 44-Page Power Tool catalog includes data on shapers, lathes, planers, drill presses, grinders, and spinning tools. Get Catalog 60 from Boice-Crane Co., or Circle Inform-A-Gram No. C14.

"New Ultrasonic Cleaning and Rust - Proofing Liquids" covers the Rust-Lick line of products and applications, directions for use, and physical properties. Get this new catalog from Rust-Lick, Inc., or Circle Inform-A-Gram No. C15.

Librascope Buys 16 Burgmaster Bench Model Turret Drills... steps up production 400%

The Librascope Division, General Precision Controls Inc. is making record savings with Burgmaster Bench Model "O" Turret Drills. After an original purchase of two machines, consistent savings in machining precision parts led to further purchases totaling 16 Burgmaster Machines.
Gear Shaft Assemblies for Fire Control Computors were formerly machined with a Single Spindle Drill producing a lot of 15 parts in 2.50 hours. Now the Bench Model Burgmaster produces the same lot in .50 hours, an increase of 400%. Savings like this are possible because POWER INDEXING of the turret rapidly performs up to six operations at operator command without tool changing and with minimum operator exertion and fixture shifting. Each spindle controlled by preselective speed and depth control.

Write for Literature—dealers in principal industrial centers.

Bench Model "O"—Price $595.00 FOB Los Angeles
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CIRCLE INFORM-A-GRAM KEY NO. 92

4-col. presses bristle with production-boosting features

KRW has done it again! This time, the 25-1000 ton KRW line of 4-column, single action hydraulic presses has been modernized to set a new pace over a broad work range.

Bristling with newness, these smooth-acting machines are built to outperform even KRW's highly regarded, prior designs in a wide variety of assignments: Blanking, forming, punching, trimming, drawing, extruding, briquetting, straightening, pressure clamping, laminating and bonding.

Already acclaimed "a marked success," KRW's latest version of the 4-column press boasts numerous features to improve quality and increase productivity: Of rugged, welded steel construction, the crown, bed and sliding platen provide maximum resistance to deflection. Align-bored to automatically controlled tolerances, the sliding platen is guided on ground and polished columns which are closely fitted into the crown and bed.

Easy to adjust, KRW hydraulic systems assure instant, complete press control. Compactly designed, the pumping unit can be mounted at the top of the press or furnished for floor installation.

Available with either up-acting or down-acting platens, KRW 4-Column Presses can be outfitted with manual lever or electric push buttons for single or continuous cycling.

For detailed information and specifications, write for Bulletin 95-D. K. R. Wilson, Inc., 218 Main St., Arcade, N.Y.

KRW HYDRAULIC PRESSES

CIRCLE INFORM-A-GRAM KEY NO. 93

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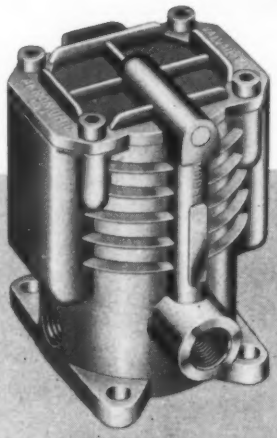
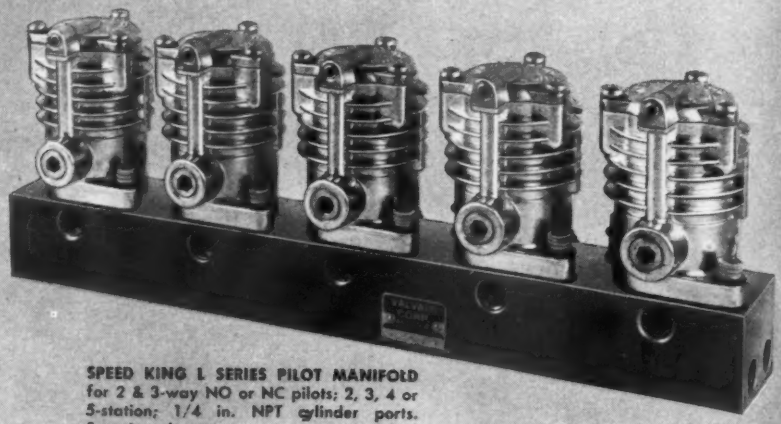
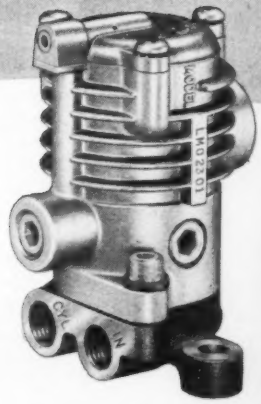
SOLENOID PILOTS



SPEED KING P SERIES PILOT 2 & 3-way NO & NC, 4-way; foot, sub-base or manifold mounting; 1/8 or 3/16 in. orifices. Foot mounting shown.



SPEED KING L SERIES PILOT MANIFOLD for 2 & 3-way NO or NC pilots; 2, 3, 4 or 5-station; 1/4 in. NPT cylinder ports. 5-station shown.



SPEED KING L SERIES PILOT 2 & 3-way NO & NC; foot, sub-base or manifold mounting; 1/16 to 1/8 in. orifices. Sub-base mounting shown.

Compact Valvair® SPEED KING pilots are ideal for control of small air or vacuum-operated devices including cylinders up to 3 in. bore, as well as for piloting larger valves. Featuring Valvair's flow-thru cooling design, they offer multi-million cycle dependability, with solenoid coils guaranteed against burn-out for the life of the valve. Choose from a full range of types, mounting styles and sizes; integral junction boxes (L Series only) and manual over-ride optional; coils for ac or dc, any voltage.

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B112-3

CIRCLE INFORM-A-GRAM KEY NO. 94

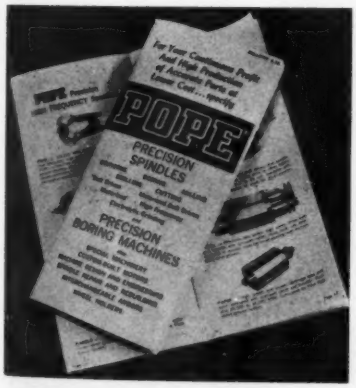
Catalogs . . .

Precision Internal Machining Problems are easily solved with data in a 6-page recessing tool bulletin. It makes it easy to select the correct recess tool holder for your specific job. Write Maxwell Industries, Inc., for Data File AT-61, or Circle No. C16.

Air Cylinders, hydraulic cylinders, accumulators, hydraulically controlled air power units, boosters, and pipe-thread fittings are all discussed in one Flick-Reedy catalog. Get Bulletin P2546P from Flick-Reedy Corp., or Circle Inform-A-Gram No. C17.

More Efficient Punching is possible with a new line of perforating units for mild steel up to ¼" thick. It's featured in a bulletin on Series HD unitized tooling. Get Catalog U95 from Tool Products Corp., or Circle Inform-A-Gram No. C18.

Seamless Steel Tubing and electric welded steel tubing are described in a catalog that gives data on carbon and alloy steel grades of seamless tubing in four categories, and carbon steel grades of electric welded type in two categories. Get Catalog CS-60 from Ohio Seamless Tube Div'n, Copperweld Steel Co., or Circle Inform-A-Gram No. C19.



Over 60 Types of precision spindles for grinding, boring, milling, slotting, and drilling are described in a new 36-page pocket size bulletin. Write Pope Machinery Corp. for Bulletin S-18, or Circle Inform-A-Gram No. C20.

Physical Properties, fabrication characteristics, and economic advantages of aluminum sheet, plate, rod, bar, extrusion, and casting alloys are described in a 24-page booklet. Get "Olin Aluminum Mill Products" from Olin Mathieson Chemical Corp., or Circle Inform-A-Gram No. C21.

Adhesives, laminating materials, and putties are listed in chart form in a condensed catalog. A temperature chart indicates the upper and lower service limits for each of the materials. Get a copy from Narmco Resins & Coatings, Co., or Circle No. C22.

Ram Benders for forming iron pipe and channels and bars of steel, copper brass, stainless, and monel are described in a catalog. Application and specification data is included. Get copy from Wallace Supplies Mfg. Co., or Circle Inform-A-Gram No. C23.

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COLD HEADING MACHINERY
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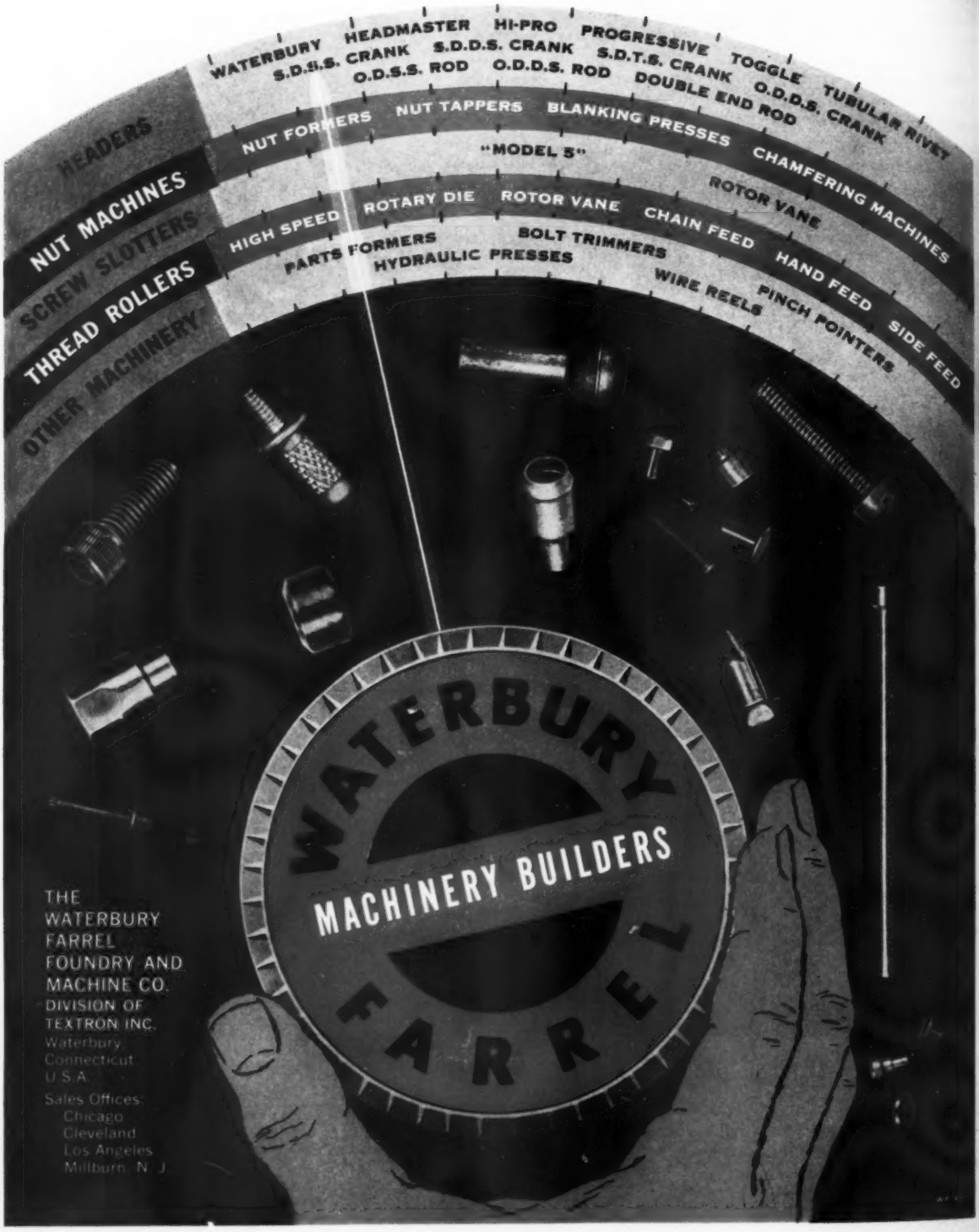

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CIRCLE INFORM-A-GRAM KEY NO. 96

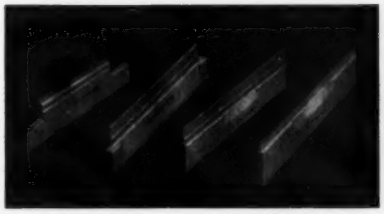
O-KNI-CO MACHINE TOOL news
PRODUCTION FACTS THAT INCREASE YOUR PROFITS
PUBLISHED BY THE OHIO KNIFE CO., CINCINNATI, OHIO

New drilling machine produces multiple hole patterns with absolute accuracy

Built by Walter P. Hill, Inc., Detroit, Mich., this opposed-spindle drilling machine has a flexible automatic system for positioning heads and table for producing hole patterns. To achieve the high degree of accuracy necessary, all components must continually operate on close tolerance. The ways, being exposed, are subjected to brutal treatment (falling steel chips, operator walking and standing on them) and consequently must have high wear resistant qualities. O-KNI-CO processed hardened ways were selected to run against O-KNI-CO processed aluminum bronze wear plates. These ways are so hard (Rockwell 66 C) as to practically eliminate galling or scoring.

Are you using flame hardened ways on your equipment?

If you are, the chances for scoring, galling and general wear are increased due to the variation in depth and quality of the hardening characteristic of this type of heat-treating. Since The Ohio Knife Co. first offered O-KNI-CO processed hardened ways some years ago, O-KNI-CO ways have become first choice with builders of quality machine tools. Special analysis tool steel of any thickness is bonded to a soft, tough, easily machinable steel. This produces a way that will not warp or bow. Special O-KNI-CO hardening process (65-66 Rockwell C) to the full depth of the tool steel, along the entire length of the way, develops fantastic wear-resistant qualities. The result is continuing accuracy of the machine under severest work loads.

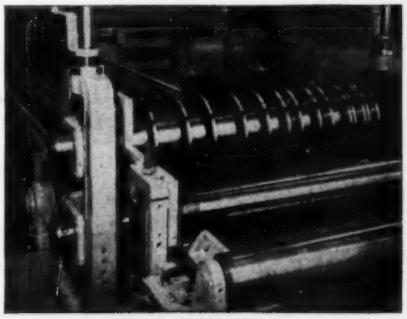


O-KNI-CO blades now standard equipment on most centerless grinders

Phenomenally long life of Ohio Knife Co. centerless work blades and guides makes them No. 1 on the blade parade. Extreme hardness, high finish, close tolerance, keeps them in operation on high production schedules. Made of tungsten carbide, high speed steel, cast alloys or iron. Non-metallic tips available. Special contours, angles or shapes made to suit requirements.

The Yoder Co., Cleveland, Ohio watch slitting costs decrease

Continuous slitting operations with an absolute minimum of downtime for re-grinding slitters is a major factor. Slitters made by The Ohio Knife Co. are widely used in this operation. Made to exacting metallurgical specifications, special heat-treating, careful grinding and finishing to tolerances of plus or minus .00025 or more are reasons why they are selected by The Yoder Co.



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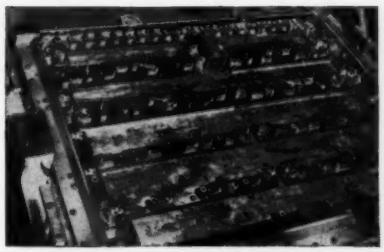

O-KNI-CO Composite Die Sections on blank and pierce die for 4' x 6' refrigerator at Ready Machine Tool & Die Co., Inc., Connersville, Ind.

A new way to build your dies

You simply order from our large stock of Composite Die Sections. They are cut to your required length or in bars 125" long. There are eleven standard cross sections with both wide and narrow lands available.

You buy them at a price *far below* what it's costing you to make them yourself. You receive them with cutting or forming edge already hardened, machined and ground. The soft steel backing, to which our specially hardened tool steel is clad, can be drilled quickly and economically for dowel and screw holes. Adjustments for wear are equally simple. Hundreds of companies who have switched to OK Composite Die Sections for Cutting, Trimming and Forming Dies, report great time and money savings, plus longer die life. New bulletin on OK Composite Die Sections and Clad Aluminum Bronze Wear Plates available.

O-KNI-CO Die Section showing tool steel bonded to mild steel backing.

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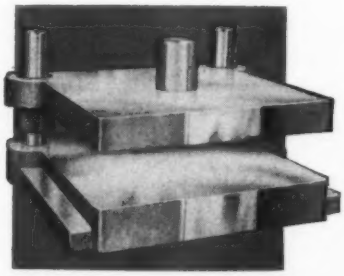

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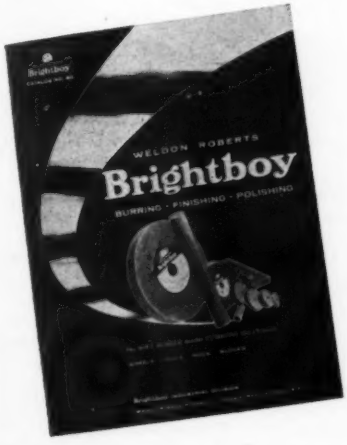
Catalogs . .

A Fast, Economical Method of cutting solids, tubing, and structurals is detailed in a bulletin. Specifications and applications of Model 2-A Sever-All dry abrasive cutting machine are presented in Bulletin DH-299 from Allison-Campbell Div'n, American Chain & Cable Co., Inc., or Circle Inform-A-Gram No. C24.

A New Miniature Turret Indexing Unit (Series I) is introduced in a bulletin that provides detailed information on its design and operation. Write Swanson - Erie Corp., for a copy, or Circle Inform-A-Gram No. C25.

A New Catalog and Price List on multiple thread milling cutters and fine pitch gear hobs, available from stock, has been issued by the Hanson-Whitney Co. Helpful selection data is included. Get a copy from Hanson-Whitney, or Circle Inform-A-Gram No. C26.

A Superalloy for Space-Age Castings, WI-52, is discussed in a bulletin that gives composition, mechanical properties, and stress-rupture testing results. Get a copy from Wai-Met Alloys Co., or Circle Inform-A-Gram No. C27.



Rubber-Cushioned Abrasives are presented in a catalog that gives application data, machine speeds, and listings of abrasive textures and stock sizes. Get Catalog 60 from Brightboy Industrial Div'n, Weldon Roberts Rubber Co., or Circle Inform-A-Gram No. C28.

A Spring Material Handbook contains a general discussion of each alloy and includes several comparison tables and charts. Write Riverside-Alloy Metal Div'n, H. K. Porter Co. Inc., for a copy, or Circle Inform-A-Gram No. C29.

A Numerical Machine Tool Control System for 2- and 3-axis positioning is presented in a brochure that describes features, operation, and specifications of the transistorized unit. Get a copy from Hughes Aircraft Co., or Circle Inform-A-Gram No. C30.

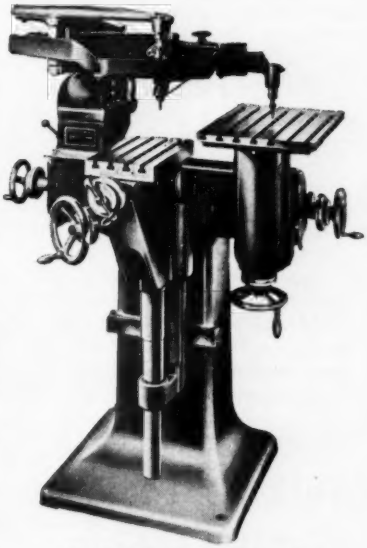
A New 42-Page Bulletin describes Farrel-Betts vertical boring mills ranging from 7′ to 42′ swing capacities and larger. Specifications of each, and descriptions of optional features available, are included. Contact Consolidated Machine Tool Div'n, Farrel-Birmingham Co., Inc., for Bulletin 1220, or Circle No. C31.

DECKEL

Engravers And Copy Millers Cut Costs, Increase Accuracy

Designed for fingertip control, the 3-dimensional pantograph of Deckel Engraving and Profiling Millers assures absolute accuracy of reproduction. Ease of operation cuts down needed production time. High surface finish requires little or no hand finishing—reducing costs even further.

Pre-loaded bearings in the pantograph provide easy guidance, playless motion, minimized vibration. Pantograph weight is delicately balanced during lowering and lifting by a spring within the column. Control and view of the entire operation is simplified by support of the master and workpiece at nearly the same level. Unlike other makes, cutter and tracer move in the same direction for all three dimensions. Reducing or enlarging ratios run from 1:1.5 to 1:10.



The Deckel GK-12 Pantograph Engraving & Profiling Miller

The Deckel GK-12 is designed to produce delicate engraving, light milling, dies for plastic molding or die casting.

The Deckel GK-21 provides increased metal cutting capacity for rough and copy milling of dies and molds up to 550 lbs.

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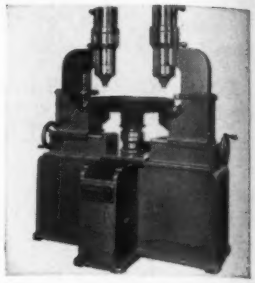

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CIRCLE INFORM-A-GRAM KEY NO. 1002

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Catalogs . .

A 32-Page Booklet describes three lines of toolholders for use with carbide inserts. Specifications, applications, ordering and dimension data are included for each. Get Bulletin T-160 from Wesson Co., or Circle Inform-A-Gram No. C32.

"A Low-Cost Approach to Automatic Drilling, Tapping, and Fastening Operations" defines and contrasts automation tools with other Buckeye air-powered tools and discusses 21K and 21L Series features. Get a copy from Buckeye Tools Corp., or Circle Inform-A-Gram No. C33.

Ultrasonic Equipment capable of cleaning flat and convolute metal filter element surfaces is described in a new technical report. The 21-page report on the Pall - Cavitron HIPS ultrasonic cleaner is available from Pall Corp., or Circle Inform-A-Gram No. C34.

A Bar and Angle Shear bulletin features a drawing illustrating the progressive shearing action of the blade when shearing bar stock and angle iron. Get a copy from The Shearease Co., or Circle Inform-A-Gram No. C35.

A New Deburring and Chamfering Grinder for spur, helical, and bevel gears is covered in a technical bulletin. Get Bulletin DCG-1 from Michigan Tool Co., or Circle Inform-A-Gram No. C36.

Resistance Welding Data is presented by a wall chart which includes specifications for spot-welding similar and dissimilar metals, projection welding data, and conversion data on commonly welded metals. Get Chart RW-5 from Ampco Metal, Inc., or Circle Inform-A-Gram No. C37.

Non-Sparking Safety Tools are described in a catalog that includes data on channelock pliers, a small adjustable end wrench, and air hammer chisels. Get this 24-page catalog from Ampco Metal, Inc., or Circle Inform-A-Gram No. C38.

"Thermoforming Techniques" discusses the machinery function, material characteristics, and performance required of vacuum forming machines. Various methods are detailed. Get a copy from Comet Industries, or Circle Inform-A-Gram No. C39.

Straight Thread Ports for Hannifin Series H hydraulic cylinders are covered in a new bulletin. Use its table to determine proper straight thread sizes for 1½" through 8" bore cylinders. Bulletin S-113-1A from Hannifin Co., gives details, or Circle Inform-A-Gram No. C40.

A New Molybdenum Mill Products specifications booklet covers unalloyed molybdenum and Mo-0.5 Ti alloy billets, bars, plates, and sheets. Refractomet Div'n, Universal - Cyclops Steel Corp., supplies copies of this 22-page booklet, or Circle Inform-A-Gram No. C41.

CIRCLE INFORM-A-GRAM KEY NO. 101

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GAP FRAME TRIMMING
STRAIGHTSIDE • TIE ROD
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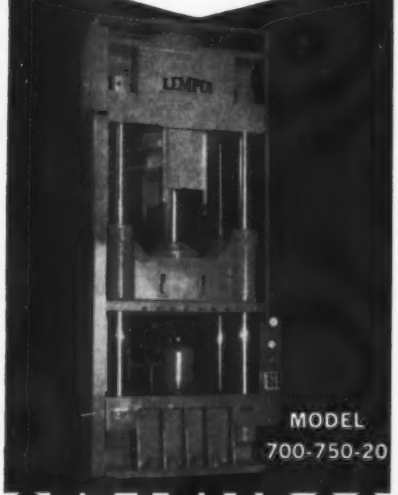

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MODEL
727-25-5

Lempco is equipped to design and build hydraulic presses to your exact requirements.

LEMPCO INDUSTRIAL, INC.
MACHINE & TOOL DIV
DUNHAM RD., BEDFORD, OHIO

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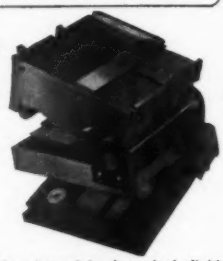
Baldy sez... When it comes to "checking the angles" you can't beat a BALD EAGLE Sine Tool.



Model 1905M

This compound angle sine plate has dual field permanent magnetic chucks that can be magnetized independently, a positive lock on each axis, and a center T slot. Like all BALD EAGLE Sine Tools, it's accurate to .0002" in dimensions and parallelisms. Other models include 5" and 10" Sine Bars and Sine Plates, single and compound, plain and magnetic.

Ask your distributor or write for complete catalog and prices.

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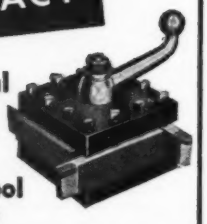
±.0005" ACCURACY



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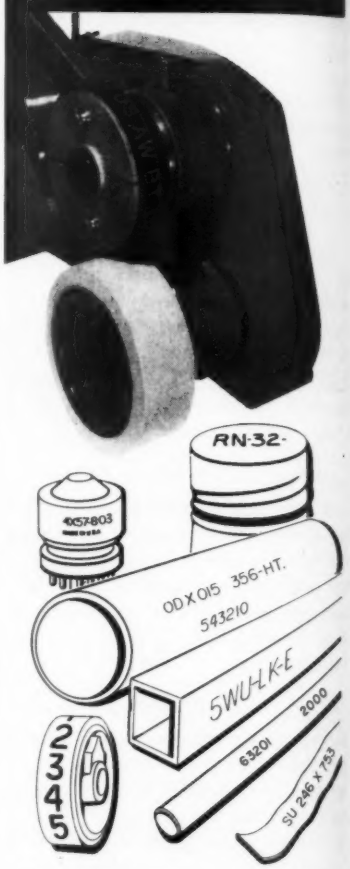

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CIRCLE INFORM-A-GRAM KEY NO. 1024

Catalogs . .

A Machine Tool Line is presented in a condensed catalog that includes data on horizontal boring, drilling, and milling machines; vertical turret lathes; vertical boring mills; and planers. Write Giddings & Lewis Machine Tool Co., for a copy of Catalog 60, or Circle Inform-A-Gram No. C42.

The Facts About Using shot and grit abrasives in blast cleaning are explained in a new 30-page booklet. Sections deal with blast cleaning functions, materials, and costs. Write National Metal Abrasive Co., for a copy, or Circle Inform-A-Gram No. C43.

A New Compact Induction Heating Unit is described in a bulletin which discusses advantages, typical applications, and specifications. Contact C. I. Hayes, Inc., for Bulletin 5910, or Circle Inform-A-Gram No. C44.

A New Collectadata Booklet gives detailed information on this data collecting system which automatically channels information from numerous work stations to a central processing point. Write for your copy to Friden, Inc., or Circle Inform-A-Gram No. C45.

Transfer Machines, production units, programming machines, standard drills, honing machines, and coolant cleaning equipment are presented in a new 8-page brochure. Get Bulletin GC-60 from Barnes Drill Co., or Circle Inform-A-Gram No. C46.

Engineering Properties of Alloys, available as rod, bar, strip, foil, and wire, and some of the services of Hamilton Watch Co., are detailed in data sheets available from the company, or Circle No. C47.

A 120-Page Manual, "Screw Machine Stock . . . Estimating and Operating Data," contains three main sections which detail properties, specifications, estimating information, and shop practices for machining the light metal. Get your copy from Aluminum Co. of America, or Circle Inform-A-Gram No. C48.

A New 24-Page Fastener catalog gives details of various tension and featherweight Huckbolt fasteners, self-broaching fasteners, self-sizing fasteners, and pull-thru blind rivets. Request a copy from Huck Mfg. Co., or Circle Inform-A-Gram No. C49.

Inflated Polishing Wheels, expanding polishing wheels, belt sanders, and expanding cones are presented in a catalog. Cost analysis sheets for comparing costs of set-up wheels vs. coated abrasive operations are also available from Nu-Matic Grinders Inc., or Circle Inform-A-Gram No. C50.

Fast Machining Bar and Tubular Steels are discussed in a bulletin which gives cost cutting speed comparisons, mechanical properties, and case histories. Contact Joseph T. Ryerson & Son., Inc., for Bulletin 12-10, or Circle Inform-A-Gram No. C51.

deep holes... perfect holes... with S&E solid carbide Bushings*

THE BORE Super precision ground and lapped to a *jewel finish*— concentric —to exact tolerance.

THE BUSHING Rigid—Solid Carbide support for *tool-control* and *long tool life.*

THE BODY Solid Carbide bearing the full length of the bore for *long run bushing accuracy.*

S&E Bushings Cost Less With long accurate bushing life (in excess of 50 times that of steel bushings), they *cut down-time* to the minimum and *boost production* to the maximum. The result is lower bushing costs, reduced inspection time, less scrap and lower tool inventory.

S&E Bushings Perform Best Extremely accurate work can be obtained with the use of these bushings, particularly where precise size and hole location are of paramount importance, or where rigid support and alignment must be maintained. *For gun drilling,* they are considered *a must* . . . they hold the bore size longer . . . they make the tool work better.

* Standard S&E bushings meet all A.S.A. standards. They are also available in all classes of (A.G.D.) gagemakers tolerances. Special and unusual type carbide bushings are regularly fabricated by S&E.

Complete catalog of S&E products available on request.

S&E MACHINE PRODUCTS INC.

Bridgeport, Michigan

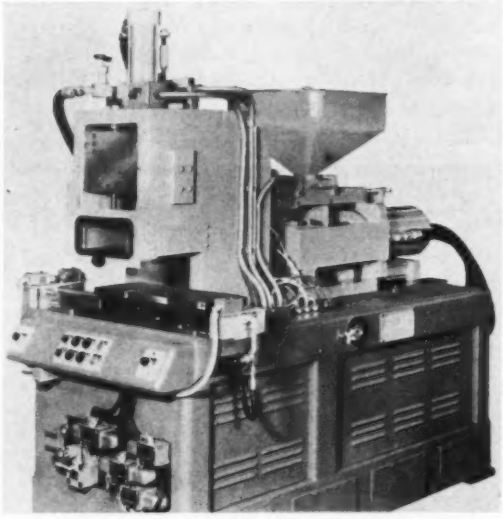
Sales offices in all principal cities.

CIRCLE INFORM-A-GRAM KEY NO. 103

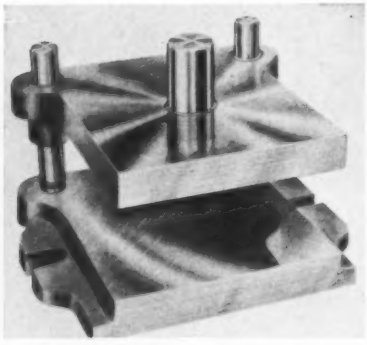
Product News

Insert Molding Machine

A new plastic molding machine with 4- to 6-oz shot capacity has features that permit insert molding with only one operator. Model 12 Duplimatic has a simplified part ejector system which allows greater flexibility in mold design and increased variations in cavity sizes. Get details from the Moslo Machinery Co., 2486 Prospect Ave., Cleveland 15, or circle No. P1.



Die Set Line



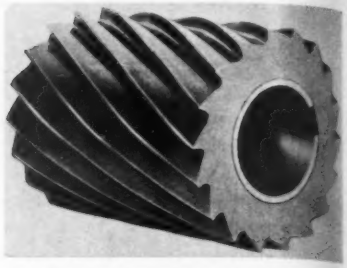
These bench, kick press, and smaller standard size die sets, in various sizes, are available in steel or semi-steel with various shapes and post arrangements. For complete data and prices, write Accurate Mfg. Co., 6641 San Fernando Rd., Glendale 1, Calif., or circle Inform-A-Gram No. P2.

New Punch Unit

The versatile type CJ unit is designed to punch both round and shaped holes. The line includes holders and die bases keyed to take shapes. Keying maintains positive, accurate alignment at all times. Get details from Wales Strippit, 212 Buell Rd., Akron, N. Y., or circle Inform-A-Gram No. P3.

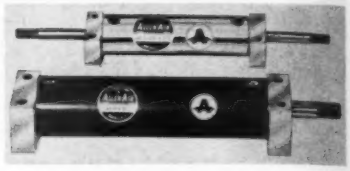
Miniature Slab Mill

For machining new superalloys, ultra-strength steels, refractory metals, and nuclear reactor metals,



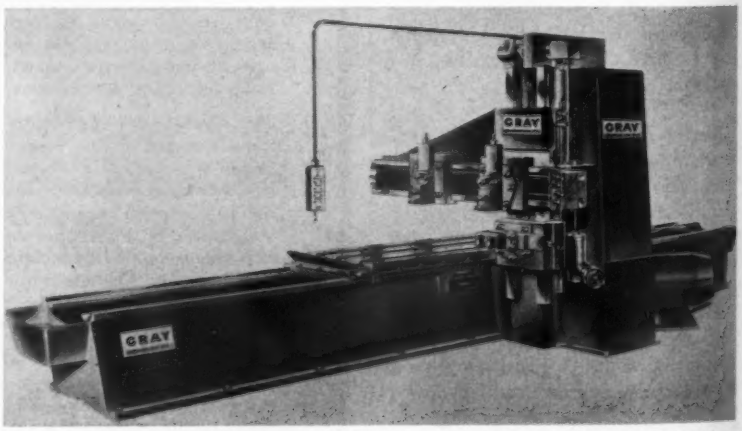
use the new solid carbide miniature slab mill. It offers the advantages of solid carbide construction with controlled flute geometry. Write M. A. Ford Mfg. Co., 1545 Rockingham Rd., Davenport, Ia., for details, or circle Inform-A-Gram No. P4.

New Cylinders



A new line of air and hydraulic cylinders, Type AS, is available in bore sizes of 7/8", 1-1/8", 1½", and 2", as either double-acting or spring-return, as well as double-ended or single-ended. The cylinders feature one-piece square heads. Literature is available from Allenair Corp., 255 E. 2nd St., Mineola, N. Y., or circle No. P5.

New Small Planer



Outstanding productivity and low cost are combined in the revolutionary new small planer announced by the G. A. Gray Co., Cincinnati 7, Ohio. The Flying Scot is available in nine combinations of table widths and heights with 30", 36", and 42" basic sizes. Get data from the company, or circle Inform-A-Gram No. P6.

HERE'S THE ENGINEERED WAY TO STORE PRECISION GAGES!

Saves Space! Time! Costly Damage!

YES, as many as 1,092 of your valuable tools and gages can be safely and systematically stored in one M & S GAGE STORAGE FILE . . . each tool in its individual compartment . . . adjustable dividers adapt for gages, taps, dies, reamers, form tools, etc.

Reinforced construction for lasting service. 3 models to meet your requirements.

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CIRCLE INFORM-A-GRAM KEY NO. 1051

ROTARY BUSHINGS

For DRILLING, CORE DRILLING, ROUGH and FINISHED BORING

The inner race of the GATCO bushing rotates with the tool, piloting the tool accurately below or above the work — or both.

Eliminates expensive tool construction — Reduces tool wear — Prevents seizure and pilot breakage — Especially adapted where precision is required.

Write for full information and prices

GATCO ROTARY BUSHING CO.
42322 ANN ARBOR RD., PLYMOUTH, MICH.
GLenview 3-2295

CIRCLE INFORM-A-GRAM KEY NO. 1052

"CUT milling down-time by 1600%"

Ford Solid Carbide End Mills — Frequent and expensive delays for end mill resharpening are a thing of the past when you use FORD SOLID CARBIDE END MILLS. In actual on-the-job comparisons, FORD tools have been in operation 16 times longer between regrinds than H.S.S. End Mills. Precision-ground by FORD, with extra long flutes, these end mills cut faster and produce a finer finish. Available in 11 standard types or in special models designed and produced to your milling requirements by FORD tool experts.

WRITE FOR DETAILED CATALOG.

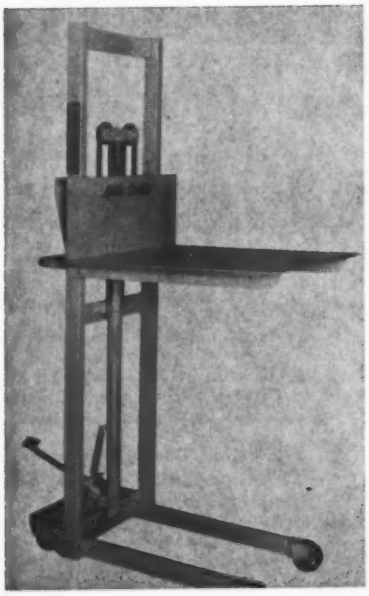
Rotary FORD Tools

M. A. FORD MFG. CO., INC. Dept. TP-560
1545 Rockingham Road, Davenport, Iowa
Manufacturers of Precision Cutting Tools

CIRCLE INFORM-A-GRAM KEY NO. 1053

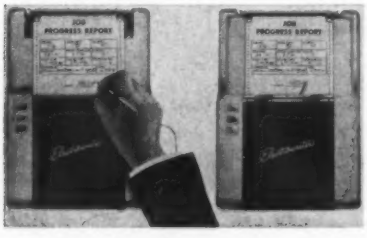
Product News

Hydraulic Lifter

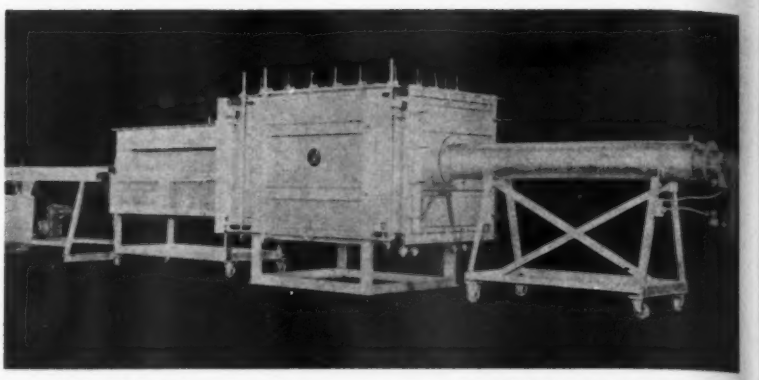


A new compact mobile hydraulic lifter and transport truck, designed for use by one man, features foot operation. Model FPD Little Dickie needs only minimum foot effort for lifting loads up to 750 lbs to a height of 64″ above floor level. Get Bulletin 115R from Langley Mfg. Co., Inc., 913 Cambridge St., Cambridge 41, Mass., or circle Inform-A-Gram No. P7.

Electrowriter



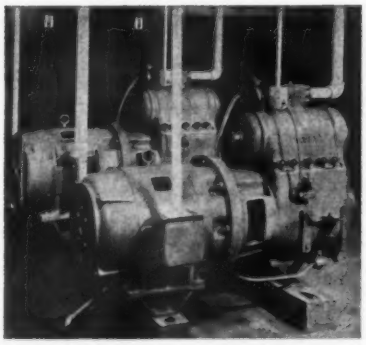
Transmit written messages or sketches anywhere in the plant or office, over telephone or radio circuits, with these units. As the pen is moved, the remote receiver (or receivers) instantly and accurately reproduces the copy as it has been written. Get details from Comptometer Corp., Electronics & Communications Div'n, 5600 Jarvis Ave., Chicago 48, Ill., or circle Inform-A-Gram No. P8.



Graphite Tube Furnaces

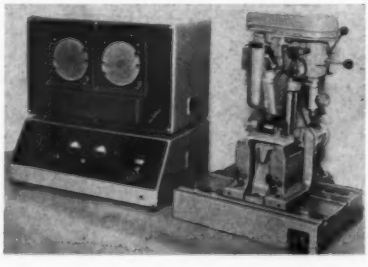
Designed to maintain continuous temperatures up to 5000°F, this graphite tube furnace line permits uniform, controlled atmosphere heating of work within a tubular graphite resistance element. They are available in 17 basic models, with heated lengths ranging from 12″ to 60″ and tube ID's from 1″ to 6″. Get Bulletin CI-1159 from Harper Electric Furnace Corp., 110 Pearl St., Buffalo 2, N.Y., or circle Inform-A-Gram No. P10.

Industrial Compressors



Ease of installation in minimum space, without complicated engineering, special machinery rooms, or foundations, is an outstanding feature of these improved 20 to 125-hp compressors. They're lightweight and compact, and only a small outlet is needed for the 180° F discharge air. Write Davey Compressor Co., Kent, Ohio, or circle Inform-A-Gram No. P9.

Dynamic Balancers



Two bench-type units, Models RO6 and R16, are ultra precise, high speed balancing machines for miniature parts such as gyroscope rotors and assemblies and fractional motors. They're designed to accept, with little or no tooling, workpieces which may be belt-air-, or electrically-driven or self-powered. Contact Cosa Corp., 405 Lexington Ave., New York 17, for details, or circle Inform-A-Gram No. P11.

Metal Working Machine

This sheet and plate working machine has a 5/32″ cutting capacity in mild steel and a 28½″ throat depth. Tooling is available for straight cutting, circle cutting, figure cutting, beading, folding, and nibbling. Contact Homestrand Machine Tool Corp., 392 W. Putnam Ave., Greenwich, Conn., or circle Inform-A-Gram No. P12.

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DECIMAL REAMERS and COUNTERBORES

WHY BUY SPECIALS
WE STOCK Thousands by the THOUSANDTHS!

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TWENTIETH CENTURY MFG. CO.
Box 429 TP Libertyville, Illinois
In emergency Telephone Libertyville 2-4200

CIRCLE INFORM-A-GRAM KEY NO. 1071

SIX ADVANTAGES OF MEIER WEARITE EXTRUDED ALUMINUM BRONZE RECTANGLES
for wear strips and wear plates

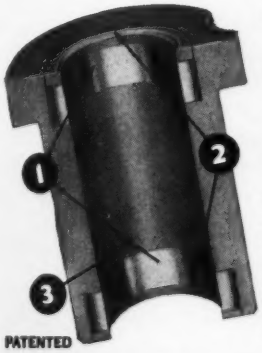
LENGTH: MEIER WEARITE is available in any length up to 10 feet.
AVAILABILITY: WEARITE comes right off the shelf of your local distributor... no waiting time for sizes now in stock.
SIZE: 94 different rectangular sizes 1/4" to 3" thick and 1" to 6" wide.
QUALITY: WEARITE is produced under strict laboratory controls. Tough (210–307 Brinell); strong (105,000 psi ultimate yield); and smooth surfaces with excellent wear characteristics.
MACHINING: Extruded WEARITE is free from porosity, and inclusions and has a homogenous structure, improving machineability.
COST: MEIER WEARITE COSTS LESS in pound for pound of usable metal than cast wear strips.

Write for technical folder or test sample at no cost.

Meier BRASS & ALUMINUM Company
1471 E. NINE MILE RD.
HAZEL PARK, MICHIGAN

CIRCLE INFORM-A-GRAM KEY NO. 1073

Does the job of Solid Carbide and MEYCO COSTS LESS!



PATENTED

1. Tungsten carbide rings at the points of wear; 2. Steel rings protect drills and carbide; 3. Special hardened alloy steel body.

There in a nut shell is the story of MEYCO carbide inserted drill jig bushings! Does everything a solid carbide bushing will do at less cost: lasts almost as long; increases life of drills and jigs; greater accuracy—longer; saves man-hours and machine down-time! All this spells high production at a lower cost. For over a decade, carbide inserted drill jig bushings have been saving money on long production runs for cost conscious customers.

Write for new Bushing Catalog No. 41

MEYCO W. F. MEYERS CO., Inc.
BEDFORD, INDIANA
A famous name in precision tools since 1888

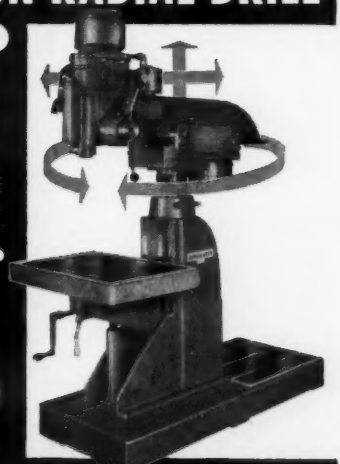
CIRCLE INFORM-A-GRAM KEY NO. 1072

MANY HOLES FROM 1 SET-UP With A
JOHANSSON RADIAL DRILL

Move the drill, not the work. Slides, elevates and rotates for quick and easy hole location.

8-speed gear drive. Proper speeds instantly—change while machine is running.

Large or small work pieces handled with ease—drill head swings 360° allowing work to be placed on front table or rear platform.



Drilling capacity ..... 1¾"
Spindle taper ..... Morse No. 4
Spindle speeds (8) .. Various Ranges
Spindle to col. (max.) ..... 36"
Spindle to work surf. (max.) .... 53"

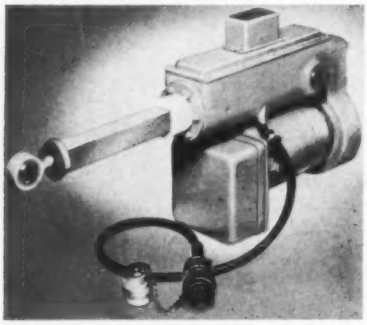
Write for new catalog today.

I. O. JOHANSSON CO. 7248 St. Louis Avenue Skokie, Illinois

CIRCLE INFORM-A-GRAM KEY NO. 1074

Product News

Industrial Actuators



A new line of actuators, specifically designed for industrial use, is electrically-driven, requiring only line current for instant operation. Model 499B can move ½-ton, hold 1½-tons. No auxiliary equipment is necessary as with hydraulic or pneumatic actuators. Several models for different jobs are available from Lear, Inc., Grand Rapids, Mich., or Circle No. P13.

New Die Steel

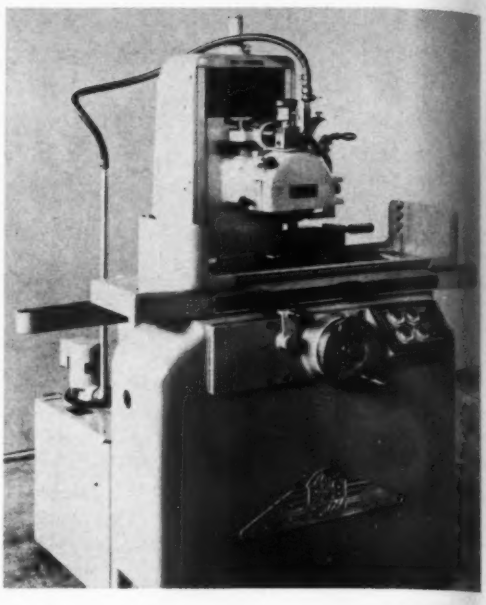
A new abrasion-resistant cold work die steel is for use in long run blanking and forming dies, brick mold liners, shot blast liners, ceramic tile liners. Get literature on BR-3 die steel from Latrobe Steel Co., Latrobe, Pa., or Circle Inform-A-Gram No. P14.

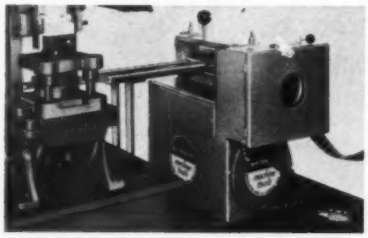
Automatic Feeding Machine

For feeding uniform, pre-determined lengths of material to any secondary machine, use the Model

Precision Surface Grinder

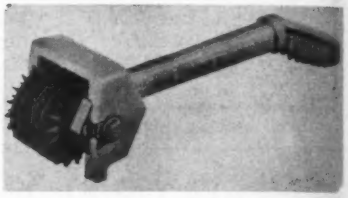
A fast cross feed method, and small depth of cut, gives rapid metal removal and prevents even localized heating of the workpieces on the new ELB Jewel 6″ x 12″ precision surface grinder. The automatic cross feed is infinitely variable 0 to 1¼ ips. Write Aaron Machinery Co., Inc., 45 Crosby St., New York 12, for details, or Circle Inform-A-Gram No. P15.





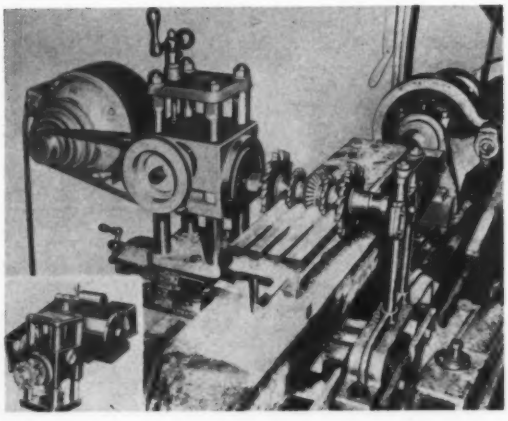
MAF machine with instant starting and stopping. The length measuring control can be pre-set to continuously and automatically produce work lengths with the 3″ to 60″ range. Write Benchmaster Mfg. Co., 1835 W. Rosecrans Ave., Gardena, Calif., for data, or Circle Inform-A-Gram No. P16.

Heavy-Duty Dresser



A new dresser, Model 22, has a 2-⅜″ dia cutter and 2′ cutting face and features an improved six-set bearing assembly which furnishes six bearing holes, eliminating wear on the exclusive pistol-grip handle. It's used for medium and large wheels and it's ideal for wide faced wheels. Get data from Machine Products Corp., 125 Hillier St., Dayton 3, Ohio, or Circle No. P18.

Portable Milling Units

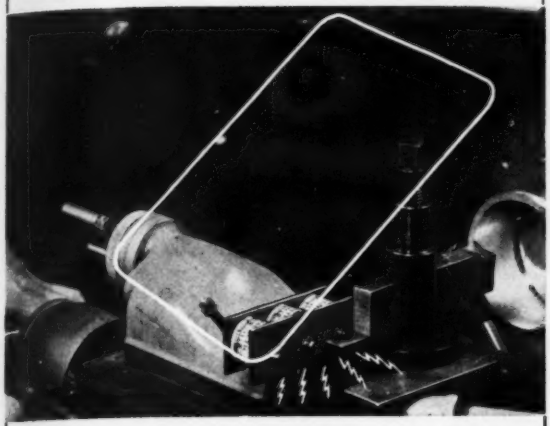


Two new unit sizes, Versa-Mil Models 1 and 3, can be attached to any standard machine tool for secondary operations without moving the workpiece. They can also be used independently in fixtured set-ups because built-in power and feeds are available. For details, write The Dumore Co., 1300 17th St., Racine, Wis., or Circle Inform-A-Gram No. P17.

Boring Tool Holders

A complete line of adjustable precision boring tool holders is especially designed for jig borers and horizontal boring machines. The Kaiser tool holders feature extremely high cutting capacity, adjustable vernier scale, radial tool bit advance, and interchangeable shanks. Contact M. B. I. Export & Import Ltd., 475 Grand Concourse, Bronx 51, N. Y., for details, or Circle Inform-A-Gram No. P19.

Magnetic
MACHINE TOOL GUARDS



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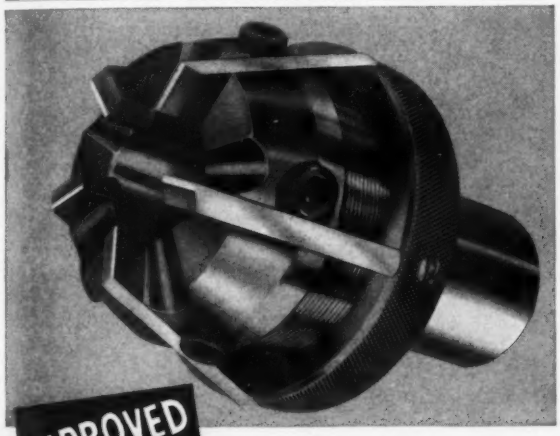

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- *Carry to jobs or fasten to bench*
- *Serves as a handy tap extension*

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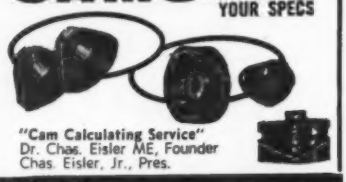

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CIRCLE INFORM-A-GRAM KEY NO. 1105

Product News

Storage System

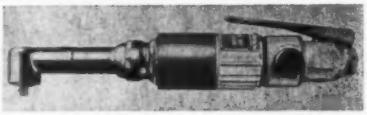
A variety of steel cabinets have been designed for the storage of industrial tools, parts, gages, components, and assemblies. The modular cabinets come in several standard heights, with interchangeable drawers also of varying heights. Write Vidmar, Inc., 2323 Reach Rd., Williamsport, Pa., for details, or Circle No. P22.

Air Compressors

The design of this line of portable, oil-free, piston-type air compressors insures maintenance-free operation by eliminating lubrication and diaphragms that rupture.

They're installed as integral parts of original equipment, pressure testing pneumatic or hydraulic installations, and remote operators of air equipment. Get Catalog W from Winslow Mfg. Corp., 3695 E. 10th Court, Hialeah, Fla., or Circle Inform-A-Gram No. P20.

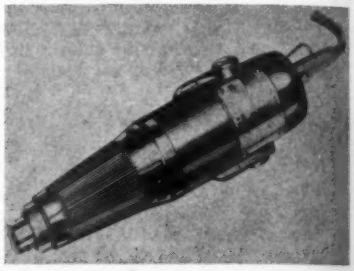
Screwdrivers-Nutrunners



A 24-member family of 90° angle-head reversible screwdrivers and nutrunners consists of four basic models. The right-angle heads provide for close-quarter operation under power, while the reversible feature permits fastening or loosening with the same tool. Buckeye Tools Corp., 5003 Springboro Pike, Dayton 1, Ohio, supplies data, or Circle No. P21.

Hand Grinder

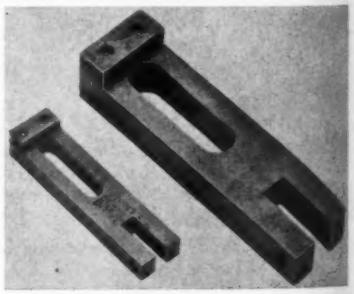
A new high-speed hand grinder, Series 40, has a higher full-load working speed, made possible by "balanced power." This motor design feature reduces no-load speed



for longer bearing life and increases full-load speed for maximum production and faster metal removal with carbide burrs or mounted wheels. Contact the Dumore Co., 1300 17th St., Racine, Wis., or Circle No. P23.

New Cam Strap

A new cam strap features a soft metal pad that's interchangeable and easily shaped to fit any work surface. The pads provide safe,

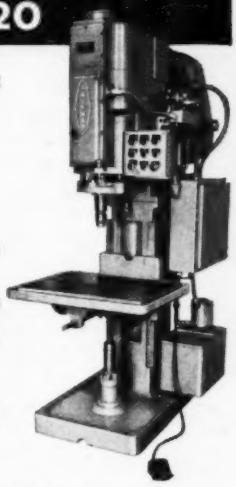


fast, low-cost clamping of rough or unfinished work. Get details from Jergens Tool Specialty Co., 712 E. 163rd St., Cleveland 10, or Circle Inform-A-Gram No. P24.

FOR HIGH SPEED PRECISION TAPPING
CHOOSE THE

kaufman

MODEL 10E-20



Six features of this new, precision-built Kaufman Tapping Machine are:

1. Lead screw control for accurate threads and maximum tool life. Maximum 4½" lead screw travel.
2. Rapid approach of spindles to work.
3. Clutch operated for faster operation – Reversing spindles at twice forward speed.
4. Six speed transmission providing spindle speeds of 80-350 RPM with 3-1 ratio or 160-700 with 1½-1 ratio clutch.
5. Units provided with 5-7½-10 H.P. Motors.
6. Speeds and H.P. available for highly efficient tapping from ⅛" through 2" NC taps or smaller taps with use of multiple head.

KAUFMAN

For additional information about the new Model 10E-20 or other Kaufman machines for single or multiple operation, write or telephone:

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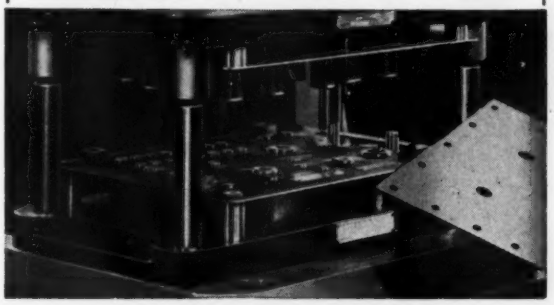

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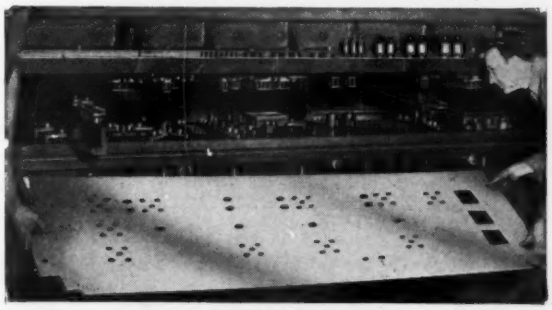

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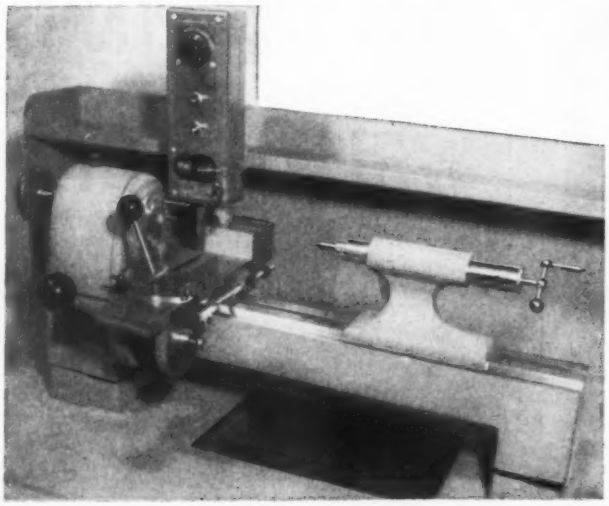

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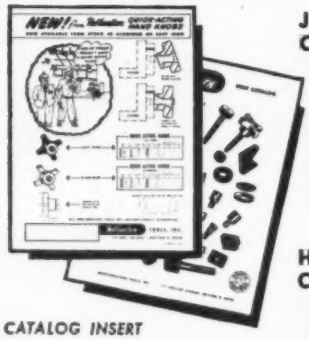

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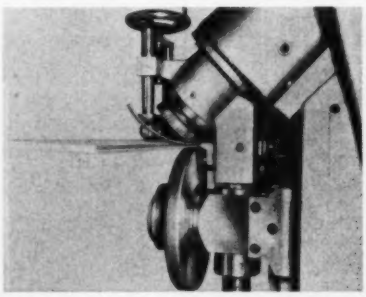
Product News

New Plate Beveller

Model X-8 beveller, designed for bevelling jobs on small hand-carried pieces for weldments, cuts a 1/2″ bevel on mild steel plate or 3/3″ stainless to prepare the seam



for a perfect arc weld fillet. On plate up to 1″ thick, both sides can be bevelled by turning the plate. Literature is available from American Pullmax Co., Inc., 2455 N. Sheffield Ave., Chicago 14, or Circle Inform-A-Gram No. P25.

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This line of low-cost pins is stabilized by precision controlled heat treatment and precision ground. Pins come in all sizes from 0.030″

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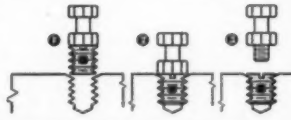

1. Drill, countersink (90° to 100°).
2. Tap National coarse thread.
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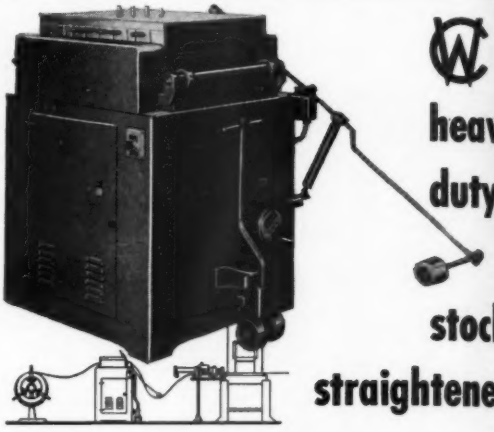

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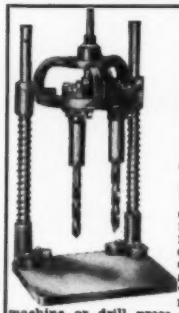

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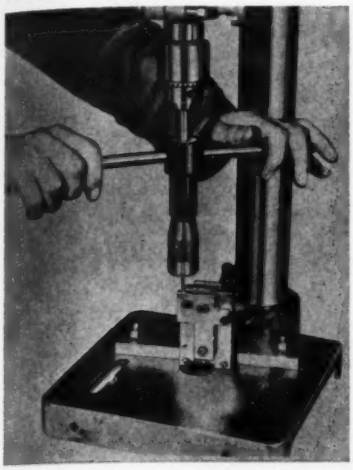
Product News

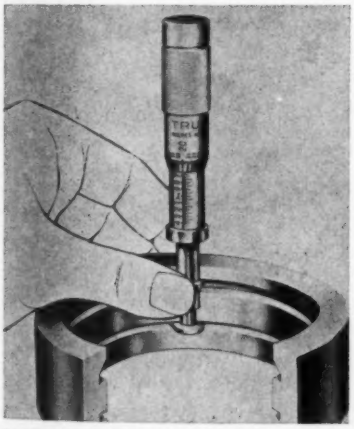
Hand Tapper & Threader



Designed as a machine tool accessory to be used on drill presses, lathes, jig borers, and vertical millers, this Grimes hand tapper is now manufactured by LeCount Tool Works, Inc., 38 Cody St., W. Hartford 10, Conn. It produces precision threads in a No. 0 to 1/2" size range and comes in two models. Get details from LeCount, or Circle No. P27.

Easily Locate Grooves

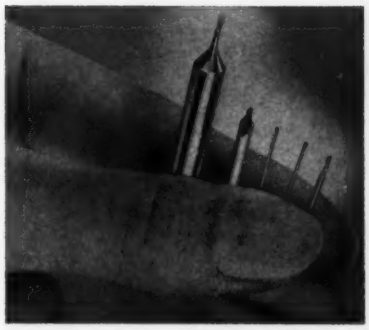
Accurately and economically locate bevelled and rectangular grooves with the Truarc groove location gage. It measures the dis-



tance from the outer wall of a bevelled or rectangular retaining ring groove to a plane of reference located 0.4" to 1.4" from the groove wall. For data write Waldes Kohinoor, Inc., 47-16 Austel Pl., Long Island City 1, N. Y., or Circle Inform-A-Gram No. P28.

Miniature Cutting Tools

Miniature twist drills, pivot drills, center drills, reamers, and end mills are included in the new line of high speed steel cutting tools announced by The DoAll Co., Des Plaines, Ill. For more information, write the company, or Circle No. P29.



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FERRO-TIC combines the fabricating advantages of steel with the wear-resistance of carbide. In the annealed, completely dense state, **FERRO-TIC** can be machined with high-speed steel tools on conventional tool room equipment; thus, the need for costly diamond grinding is eliminated. Once hardened, by oil quenching from 1750° F, **FERRO-TIC** is extremely hard and wear-resistant. **FERRO-TIC** stock blanks can be fabricated into long-wearing carbide components, using available tools and skills without delay!

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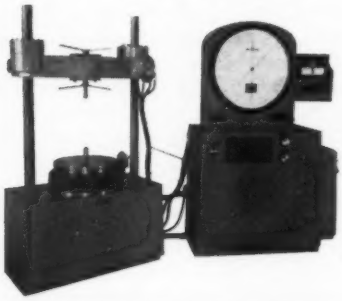
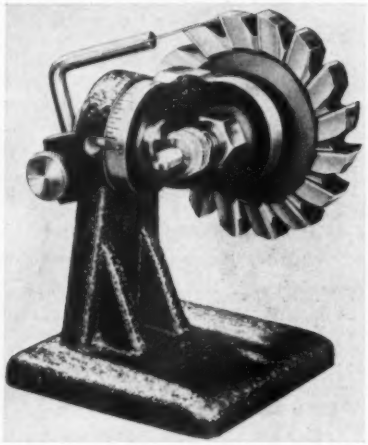
Product News

Push-Pull Testing Machine



In addition to routine universal testing, this new push-pull testing machine can alternately apply tension and compression loads to the same specimen. Accurate dial indication of applied load is provided in either test direction on the large 28″ dia SelecTrange dial. Get details from Tinius Olsen Testing Machine Co., 138 Easton Rd., Willow Grove, Pa., or Circle Inform-A-Gram No. P30.

Cutter Grinding Fixture

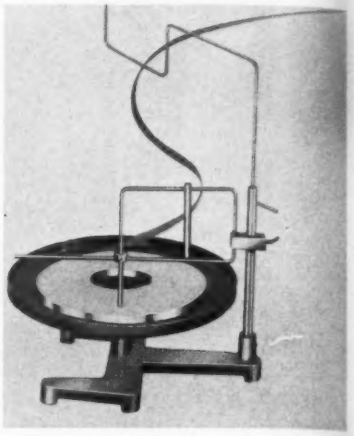


For grinding and sharpening plain milling cutters up to 6″ dia on horizontal surface grinder, use this new low-cost cutter grinding fixture. In many cases it eliminates the need for a universal tool and cutter grinding machine. Contact Montgomery & Co., Inc., 401 Morris Ave., Springfield, N. J., for details, or Circle No. P31.

Plastic Tubing

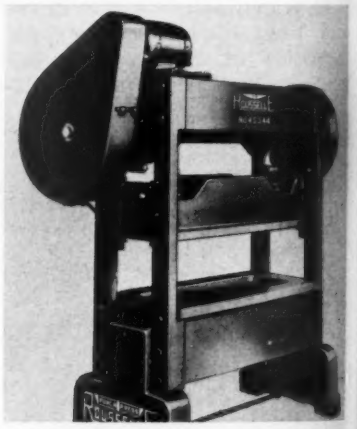
Fibre glass plastic tubing fabricated in both square and round shapes, with laminations of epoxy resin and glass cloth, are available from Ren Plastics. Large and small sizes are available in both shapes. Get details from Ren Plastics, Inc., 5422 S. Cedar Rd., Lansing 9, Mich., or Circle Inform-A-Gram No. P32.

Automatic Stock Reel



The natural spring of the uncoiling stock rotates the ball-bearing mounted platen in this new automatic stock reel. Disassembly is unnecessary when loading, and the stock reel takes up to 6″ wide material of any thickness. For data, write Durant Tool Co., 15 Thurbers Ave., Providence 5, R.I., or Circle Inform-A-Gram No. P33.

Straight Side Press



This 40-ton Rousselle press is ideally suited for handling wide rolls or sheets of stock. Four long ways provide rigid corner ram support, making it adaptable for steel rule dies and a variety of multiple punching. Ask for data from Services Machine Co., 2310 W. 78th St., Chicago 20, or Circle Inform-A-Gram No. P34.

A simple, effective, low cost
ANTI-CORROSION TREATMENT
during storage, production and shipment

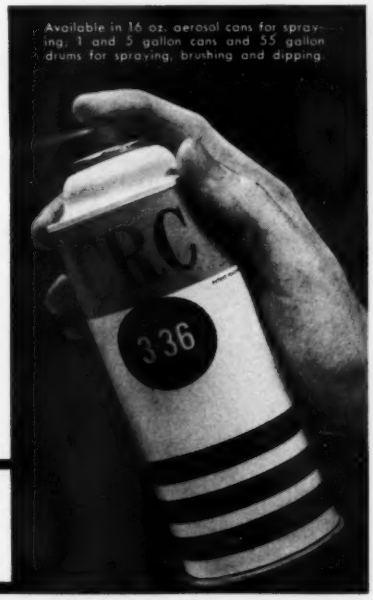
CRC

FORMULA 3-36 METALS INDUSTRY

A molecular film that first displaces moisture from grain boundaries, pores and cracks and then seals the surface against corrosive action, CRC 3-36 keeps metal surfaces new. Easily applied by spray, brush or dip, CRC 3-36 never becomes hard or brittle, normally need not be removed when metal is subsequently processed. Non-irritating and non-toxic to humans, has faint pleasant odor.

Also preserves tools, dies and fixtures, loosens "frozen" parts, has beneficial lubricating effect.

WRITE TODAY! *Send for free copy of CRC 3-36 Bulletin which gives complete product specifications and describes cost-saving applications.*


Available in 16 oz. aerosol cans for spraying, 1 and 5 gallon cans and 55 gallon drums for spraying, brushing and dipping.
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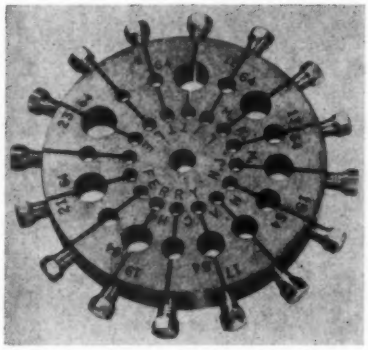
CIRCLE INFORM-A-GRAM KEY NO. 1173

Product News

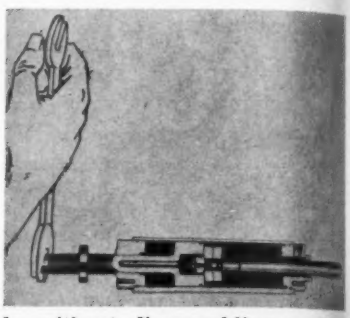
Lapping Unit

Lap reamers that are cutting oversize to precision sizes, without removing them from the machine setup, with the new Clusterlap. It provides for lapping reamers and standard drills to off sizes with close tolerances, to achieve perfect dimensions. For details, write M K M Machine Co., 325 Main St., Little Ferry, N. J., or Circle Inform-A-Gram No. P35.

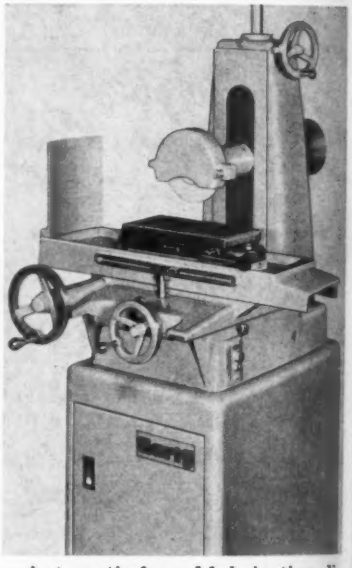


Adjustable Stroke Cylinder

Easily shorten or lengthen the stroke of this air and hydraulic cylinder, with micrometer accuracy, by turning the rod. It's done quickly without disassembling or dismounting the unit, or without adding extra parts. It's round, and available for 150 psi air pressures, 500 psi hydraulic pressures; in 1½" to 8" bores, with oversize rods. Get details from Ortman-Miller Machine Co., 19 143rd St., Hammond, Ind., or Circle No. P36.



Precision Surface Grinder



Automatic forced lubrication, direct-drive motor, and choice of right- or left-hand longitudinal feeds as standard equipment are offered on the new Harig 612 precision surface grinder. These desirable features greatly simplify grinder operation and maintenance. For details, write Harig Mfg. Corp., 5757 Howard St., Chicago 48, or Circle Inform-A-Gram No. P37.

here's why GTS marking tools offer
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Engraving Zone precision—performance proved steel—wide experience, ASSURES LONG TOOL LIFE

In the critical Engraving Zone, the faces and bevels of engraved characters must be cut with precision on selected tool steel . . . for tool performance stamina and sharp impressions.

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IF IT'S WORTH MAKING, IT'S WORTH MARKING

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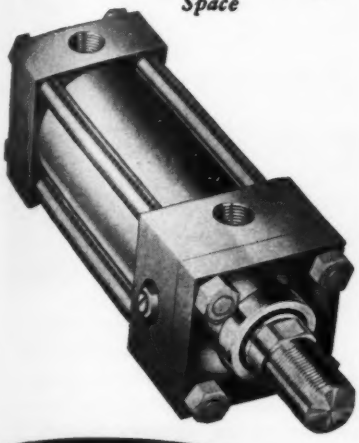
Maximum Working Force in Minimum Working Space



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Also in Stock:
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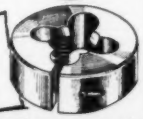
- SPECIAL REAMERS
- EX. LONG DRILLS



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Quotations on Request

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BRINELL

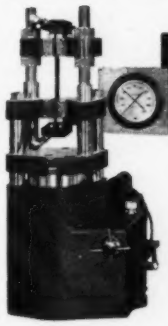
Standard Brinell testing machines. Direct reading, long stroke, and many other modifications available.

Special Models Too!

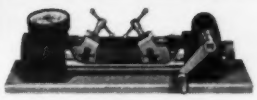
DUCTILITY

Hydraulically powered 3/16-inch capacity sheet metal testers have up to 30,000-lb. load.

FOR THE BEST BUY DETROIT TESTING MACHINES



TENSILE



Hand-operated portable tensile tester has 4,000 lb. capacity. Hydraulic bench models have up to 40,000-lb. capacity.

Write today for more information.

DETROIT TESTING MACHINE COMPANY
9386 Grinnell Avenue, Detroit 13, Michigan

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ALINA SERIES "W" BORE GAGES

Range from .160" to 12"

Alina bore gages are extremely sensitive and designed for trouble-free operation.
The three point centralization system locates the gage in the hole quickly and accurately.
Alina bore gages will swiftly reveal taper, bell mouth, out of round, and other dimensional variations.

A push-button retracts the movable anvil for easy non-scratching insertion into the workpiece. This feature also saves wear on the anvils.

Each gage is equipped with tungsten carbide contact points for lasting on the job accuracy. (except model WO-1).

Bore gages with measuring depths up to 40" delivered on special order.
Model WO-1 available with measuring heads down to .160".

Furnished as a set complete with depth adjustment stops and fitted wooden case.

ALINA WRITE FOR ILLUSTRATED LITERATURE

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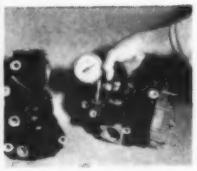
CIRCLE INFORM-A-GRAM KEY NO. 1194

Here's what they're using to gage precision bores on...

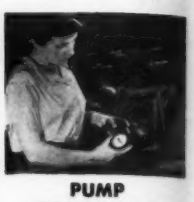
AIRCRAFT ENGINE


FUEL CONTROL UNIT

BALL BEARING HOUSING

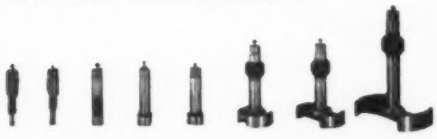
TRACTOR HOUSING

AIRCRAFT PART


PUMP COMPONENT

and here's why...

For holes ⅛" to 10" diameter



Comtorplug's unique expansion principle gives automatic 2-point gaging shown as a fixed reading to a fraction of the large clear .0001" graduations. With its true 2-point gaging, you can see the diameter at any point of the bore, detecting front or back taper, ovality, barrel shape, bell mouth, etc. If you have a fast-moving volume-precision program, learn why others have adopted this "tells-all" gage by the thousands. It's not expensive. Write for details.

Comtor Company, 82 Farwell Street, Waltham 54, Mass.

REQUEST BULLETIN 50

COMTORPLUG with interchangeable expansion plugs to gage simple or special holes to a fraction of .0001".

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CIRCLE INFORM-A-GRAM KEY NO. 1202

re·li'a·ble: That which can always be counted upon to do what is expected or required

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Micro-deburring, Smoothing, Cleaning, Polishing

Cratex reliability lowers costs

You can count on every Cratex item to perform just as you expect it to—exactly as the last one did and as the next one will. This is the key to efficiency in micro-deburring, smoothing, cleaning and polishing. YOU SAVE TIME because you know just what to expect in performance without experimenting or compensating. YOU SAVE REJECTS because with Cratex no unexpected irregularities occur to spoil work pieces.

WHEELS • POINTS • BLOCKS • STICKS • CONES in 4 grit textures for power or manual application. Sold through leading industrial supply distributors.

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CRATEX

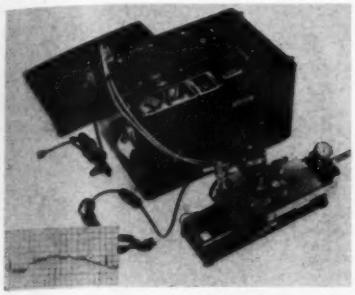
MANUFACTURING COMPANY, INC.

1600 Rollins Road Burlingame, Calif.

CIRCLE INFORM-A-GRAM KEY NO. 1203

Product News

Gear Tester



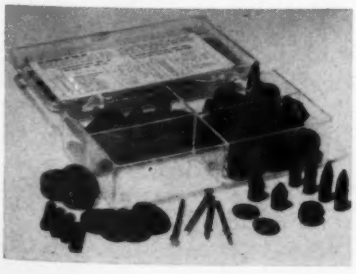
A variety of testing jobs can be handled by this electronic gear tester, which uses the Sanborn electronic recorder coupled with one of several Scherr gear testers. The recorder can be calibrated to any ratio within the limit of the recording tape. One line on the paper can be made to equal from 0.00005" to 0.001". Write Scherr-Tumico Co., 200 Lafayette St., New York 12, for literature, or Circle Inform-A-Gram No. P38.

Accurate Comparator

A special design of frictionless amplification eliminates friction, backlash, and lag, and therefore insures perfect repeat readings with this comparator. Because the Mikrom is completely mechanical, it doesn't have to be warmed up. Write Mueller Gages Co., 1052-1058 N. Allen Ave., Pasadena, Calif., or Circle Inform-A-Gram No. P39.

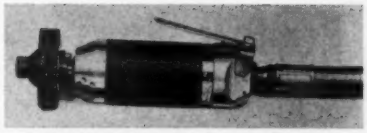
Rubberized Abrasives

A kit of rubberized abrasives is ideal for tool and die makers for demonstrating the advantages of rubberized abrasives in solving sensitive deburring, smoothing, and polishing problems. For details on Kit 777, write Cratex Mfg. Co., Inc., 1600 Rollins Rd., Burlingame, Calif., for a catalog, or Circle Inform-A-Gram No. P40.



Small-Wheel Grinders

These pneumatic grinders have ten operating speeds for driving small grinding wheels, rotary files,



carbide burrs, and sanding and cutting discs. Series 921 grinders are intended for burring, die grinding and contouring, flaw removing, and snagging. Get data from Thomas C. Wilson, Inc., 21-11 44th Ave., Long Island City 1, N.N.Y., or Circle No. P41.

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The **MIPSA** universal grinder combines functional design with proven performance to offer you the ultimate in accuracy and versatility.

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ALINA Write for illustrated brochure and the address of nearest showroom.

ALINA CORPORATION

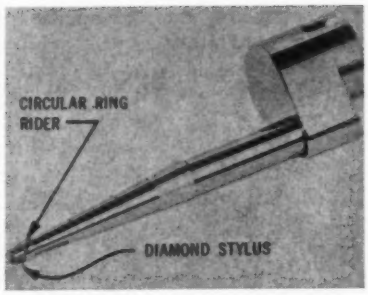
122 East Second Street, Mineola, Long Island, New York

CIRCLE INFORM-A-GRAM KEY NO. 121

Product News

Small Bore Adapters

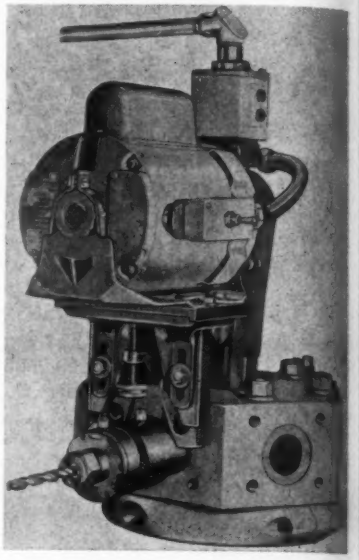
Extend the utility of surface finish measuring units to very small internal diameters and other limited access areas by using two small bore adapter models. BL-113 handles gear teeth, slots, and lands, while BL-134 is for small bores, gear teeth, and slots where hand-held operation is necessitated by



location of the surface to be measured. Get details from Brush Instruments, Div'n of Clevite Corp., 37th & Perkins Ave., Cleveland 14, or Circle No. P42.

Drilling Attachment

Deep hole drilling with greater speed and accuracy is possible with the new deep hole drilling attachment for turret lathes. A complete-



ly adjustable self-contained unit, it fits into any hole on the turret without interfering with other positions. Get details from Boyar-Schultz Corp., 2000 S. 25th Ave., Broadview, Ill., or Circle Inform-A-Gram No. P43.

Double-End Straps

A new strap with pads on both ends, a double holding feature, is one of the new items manufactured

by Jergens Tool Specialty Co., 712 E. 163rd St., Cleveland 10. The strap is carburized and hardened to approximately 1/16" deep. Contact the company for details, or Circle Inform-A-Gram No. P44.

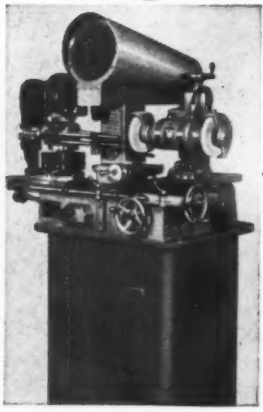
So what's all the commotion about this R-O Universal Form relieving Fixture and Grinder?

So we've been sharpening tools for 30 years without problems—Why change?

So it makes a cheap cutter last a little longer—Probably costs a lot more than it saves!

So it makes a tool cut a little cleaner—We don't have quality problems—We're satisfied with our speeds!

So I should spend a lot of money when I'm getting by OK?



Keep talking, mister—your comments and doubts ring a familiar note! But, get all the facts. Your appraisal may not be fair to yourself. Some of the most enthusiastic users of R-O equipment were doubters first. Let us send literature.

R-O MANUFACTURING COMPANY
31171 Stephenson Highway, Madison Heights, Mich.
Please forward the R-O catalog

Firm .....
Address .....
City..... Zone..... State.....
Per .....
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CIRCLE INFORM-A-GRAM KEY NO. 122

Mahr INDICATING MICROMETER and COMPARATOR With the VISIBLE FEEL

WILL DETECT OUT-OF-ROUNDNESS — OVALNESS — TAPERED CONDITION IN 1/10,000" — 0-1" Range

TENTHS VERNIER

ONLY $99.50 IN HARDWOOD CASE

LARGER SIZES UP TO 12" AVAILABLE

Cat. #40 SF

A RIGHT HAND TOOL
Release Button for Movable anvil on right hand side enables operator to hold tool the conventional way.

NEW! Resetting to Zero in Seconds. Quick Adjustable Tolerance Hands. HEAVY TUNGSTEN CARBIDE tipped Measuring Anvils. STAINLESS STEEL, one-piece spindle and screw, hardened with Ground Threads — Permanently Rustproof.

3 TOOLS IN ONE
COMPARATOR
Master MICROMETER
"GO" & "NO GO" GAGE - 1" Range in .0001"

GUARANTEED Mahr QUALITY
INDICATING BENCH MICROMETER with NON-ROTATING Spindle
Range 0-1"
Cat. #40 MSF
ONLY $170.00 IN HARDWOOD CASE

Reading .000050" from dial.
Directly reading in .0001" from micrometer.
1-3/4" thimble dia.
Dull chrome finished.

Here is a SUPER PRECISION MEASURING MACHINE for the measuring of small and delicate parts for Tool and Instrument making.

USE IT AS A COMPARATOR
Anvils RETRACTABLE for rapid repeat measurements.
Adjustable Tolerance Hands.
Instant Zero adjustment of indicator.

FEATURING . . .
Adjustable Measuring Pressure to any desired tension.
Non-rotating Spindle assuring absolute parallelism of anvils.

20 MILLIONTHS INDICATOR READING AVAILABLE

Eleven Types of INTERCHANGEABLE Measuring Anvils available.

IF NOT AVAILABLE AT YOUR FAVORITE SUPPLY HOUSE — WRITE TO US FOR ILLUSTRATED FOLDER.

MAHR GAGE CO., INC.
274-TO Lafayette St., New York 12, N. Y.

HEADQUARTERS FOR PRECISION MEASURING INSTRUMENTS AND FINE TOOLS

CIRCLE INFORM-A-GRAM KEY NO. 1231

ARMSTRONG
TOOL HOLDERS

A Correct Tool for Every Lathe Operation

You can save time (and money) by ensuring that your machine tools are equipped with *adequate numbers* of the correct ARMSTRONG Tool Holders. The ARMSTRONG System of Tool Holders includes correctly designed tools for *every* standard operation on lathes, shapers, and planers, and for many operations on turret lathes and screw machines. By utilizing the ARMSTRONG System of Tool Holders, you can reduce tooling costs, eliminate down time in tooling up, operate your machine tools at maximum feeds and speeds.

ARMSTRONG Tool Holders are long-lasting tools. They are strong beyond need, handy and efficient, profitable to use, and are readily available from your local ARMSTRONG Distributor.

Check over your ARMSTRONG Tool Holder needs. Write for literature.

If you do not know the name of your local ARMSTRONG Distributor, inquire when asking for literature.

ARMSTRONG BROS. TOOL CO. 1330 W. ARMSTRONG AVE. CHICAGO 40, ILL.

CIRCLE INFORM-A-GRAM KEY NO. 1232

1/3 SIZE

Malleable Casting Redesigned to Stamping Becomes Standard Equipment for Lathe Maker

This malleable cast spanner wrench, used for the handwheel draw-in attachment on a precision bench lathe, involved an elaborate set of patterns, two machining operations plus grinding and finishing. Converting to a die-cut stamping gave improved appearance, reduced weight and better quality. Lots of 100 cost no more than six previously handmade wrenches.

Bulletin F185 explains the highly efficient, specialized, D-R technique of utilizing temporary tooling to produce short-run stampings that cut the work load—and costs—of metal fabricators. Write for it. A print and/or sample, plus quantity, will bring a prompt quotation without obligation.

DAYTON ROGERS
Manufacturing Company
MINNEAPOLIS 7B, MINNESOTA

CIRCLE INFORM-A-GRAM KEY NO. 1233

NEW! *for tool and die makers* . . . . . Scribe-IT

MARSHALL'S TIME SAVING COMBINATION in the most popular sizes of: O1 Lcat GROUND FLAT STOCK

Pre-colored • Oversize PREPARED TOOL STEEL

Cost Saving!

18" and 36" lengths

Ready for scribing and layout.
Method of pre-coloring does not change size.
Same price as Standard Flat Stock.
Resists rust.
Permanent identification.
Can be finished to Standard size after heat treatment.
Retains 25 to 35 R.M.S. (Micro finish).
Protected fully and easily distinguished by new Scribe-IT aluminum foil packaging.
Available in practical range of sizes for tool and die making.
Pre-colored and Oversize but retains accuracy of dimensions.

Write for descriptive literature and prices

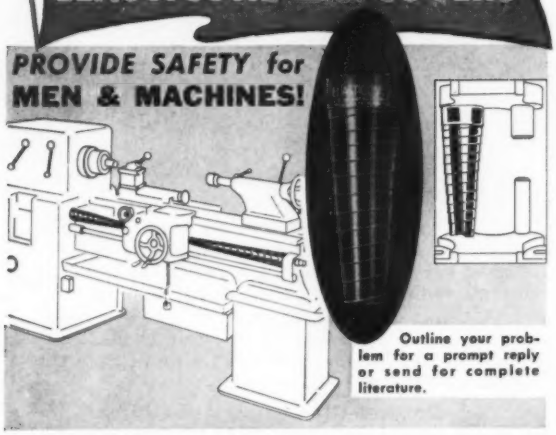
MARSHALL STEEL COMPANY
Box 198 TP
La Grange, Illinois

CIRCLE INFORM-A-GRAM KEY NO. 1234

OUT GO SHUTDOWNS . . . INJURIES . . . REPAIRS

ELASTICONE® STEEL RIBBON **COVERS**

PROVIDE SAFETY for MEN & MACHINES!



Outline your problem for a prompt reply or send for complete literature.

Elasticones are metal-formed, cone shaped covers that open and close automatically to provide protection against dirt, damage, and catching of limbs, for all precision moving parts. Available in all finishes and sizes from 3/8" diameter up to 60" long.

Stocking distributors in principal cities

ELASTICONE DIVISION

CENTRAL SAFETY EQUIPMENT CO.

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LASSY TAPPERS . . .

Lassy Tappers make tapping easy, fast and simple. Exclusive patented features eliminate guess work, drastically reduce labor costs, save taps.

3 SIZES.

FREE ILLUSTRATED CATALOG AND PRICES.

UNCONDITIONALLY GUARANTEED

LASSY TOOL CO.

PLAINVILLE, CONN.

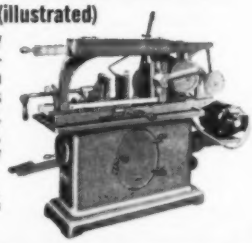
CIRCLE INFORM-A-GRAM KEY NO. 1242

Pressure Feed Control Speeds Cutting on KELLER Power Hacksaws

MODEL 3CH, 6-3/4" x 6-3/4" (illustrated)

Fastest cutting feed pressure is easily set on KELLER HY-DUTY POWER HACK-SAWS and automatic lift on return stroke saves on saw blades. Features include built-in coolant tank and pump, 45° swivel vise, foot lift to saw frame, Oilite bearings throughout and many others.

5 Sizes (4" x 4", 5" x 5", 6-3/4" x 6-3/4", 8-1/2" x 8-1/2", 10-1/2" x 9") in 10 Models provide a saw for every requirement.



KELLER DIVISION

Sales Service Mfg. Co.

2361 University Ave., St. Paul 14C, Minn.

Ask your Industrial Distributor or write for Bulletin 257 with full description and prices.

CIRCLE INFORM-A-GRAM KEY NO. 1243

Gage Block Precision means

GRADE "A" ACCURACY*

with **ULTRA-CHEX GAGE BLOCKS**

82 PIECE SET...

NOW ONLY **$249.50**

*Grade "A" Accuracy: −.000002" and +.000006"

For Complete Information request our 96 Page Catalog — Contact any of our 4 "Coast to Coast" Locations or your nearest Local Distributor.

SCHERR-TUMICO

PRECISION MEASURING TOOLS AND INSTRUMENTS

WAREHOUSE STOCK, SHOWROOMS & SALES OFFICES AT

NEW YORK: 200 Lafayette Street, New York 12, N. Y.

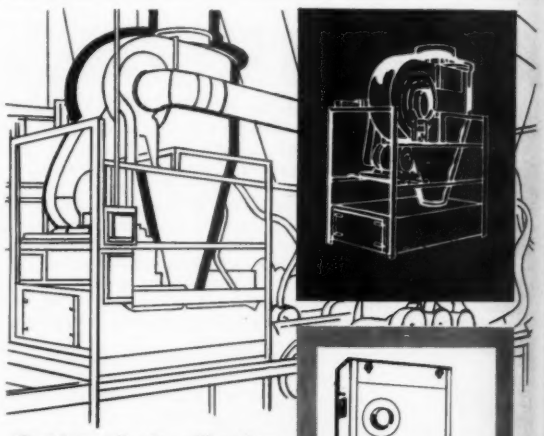
ST. JAMES: St. James, Minnesota

LOS ANGELES: 3337 West Olympic Blvd., Los Angeles 19, Cal.

CHICAGO: 5045 W. Harrison, Chicago 44, Ill.

When writing to any of the above locations, refer to DEPT E-5

CIRCLE INFORM-A-GRAM KEY NO. 1244



Custom dust collection —with a standard unit . . .

Regardless of your dust collection problem, chances are there is a space-saving Dustkop model to fit the job. Aget, for years, has led the field in efficient, compact design and has developed more than 50 standard Dustkop collectors. Each is job-tailored to most grinding, buffing or finishing operations—as well as many other types of service. Write for illustrated brochure that helps select your tailored Dustkop unit.

Also a complete line of mist collectors

C.S.A. APPROVED. Write for name of nearest representative in Canada

AGET MANUFACTURING COMPANY DUSTKOP

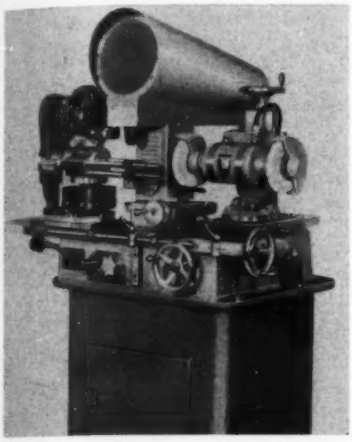
1394 EAST CHURCH ST., ADRIAN, MICHIGAN Stops Dust

CIRCLE INFORM-A-GRAM KEY NO. 1245

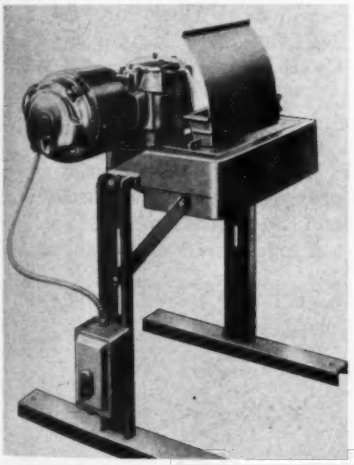
Product News

New Optical Comparator

Here's a new precision optical comparator that can be mounted on R-O grinders as well as other makes. The 9" dia screen is mounted in a protractor ring. The comparator can be swung into position for checking (shown) or out of the way for grinding. Get details from R-O Mfg. Co., 31171 Stephenson Hwy., Madison Hgts., Mich., or Circle Inform-A-Gram No. P45.



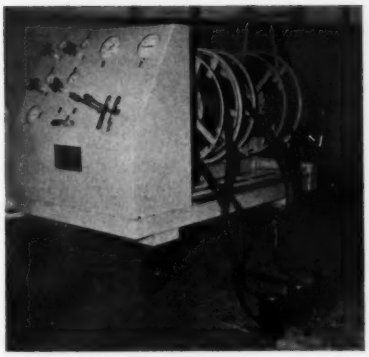
Improved Scrap Choppers



For efficient cutting at increased operating speeds, use the new improved power press scrap choppers. The units chop skeleton scrap as it comes from the press into a size easily handled and stored for collection. Cooper Weymouth, Inc., 600 Honeyspot Rd., Stratford, Conn., supplies information, or Circle Inform-A-Gram No. P46.

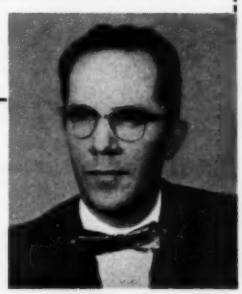
Hydraulic Jacking Unit

Precision control of multiples of hydraulic jacks or cylinders is provided by this new portable setup. Each jack raises or lowers at the same rate, keeping the same level regardless of the weight on each jack. The unit operates four 30,000 lb capacity jacks with a stroke of from 2" to 12". Write Modern Hydraulics, Inc., 130 W. Grand Lake Blvd., W. Chicago, Ill., or Circle No. P47.



"FASTAX EXPOSES CAVITATION DAMAGE of METALS"

writes W. C. LEITH
of DOMINION ENGINEERING COMPANY, LTD.



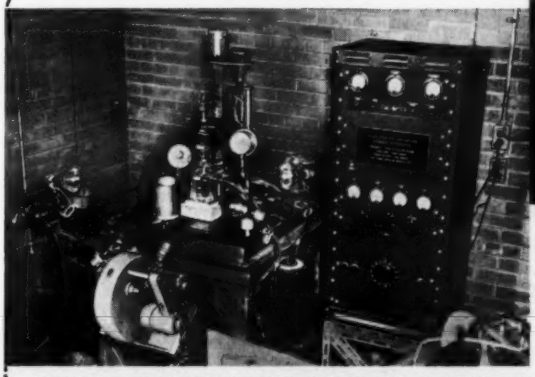
W. C. Leith winner of the Engineering Institute of Canada (1959) Duggan Prize and Medal for his paper "Cavitation Damage of Metals."

"A FASTAX camera has been used in our cavitation research program. The model WF-4 at 8,000 frames per second identified the bubble pattern on a test button subjected to accelerated cavitation in distilled water." (Films show cavitation bubble pattern similar to damage pattern).

"The FASTAX camera, providing a time magnification factor of 500 for this work, contributed substantially to the exploration of this somewhat obscure subject."

W. C. Leith

Here's Proof:



Bubble pattern on vibrating test button.

Accelerated cavitation apparatus with FASTAX camera ready to record results.

LET FASTAX HIGH SPEED PHOTOGRAPHY HELP SOLVE YOUR ENGINEERING ANALYSIS PROBLEMS

WRITE for more detailed information and literature.

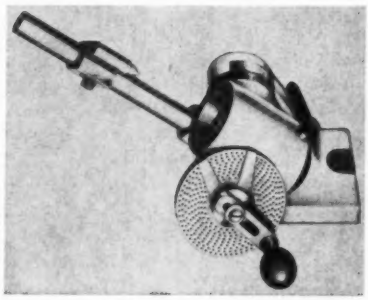
WOLLENSAK
OPTICAL COMPANY • ROCHESTER 21, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 125

Product News

Versatile Dividing Head

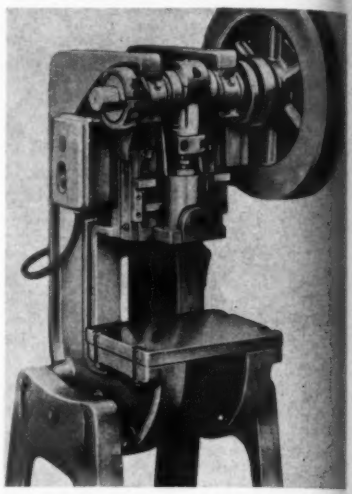
Produce small precision parts with a minimum of setup time and effort in instrument and model shops, using this new versatile dividing head. It features minimum overhang and height and weight which, in addition to attaining maximum rigidity, allows the head



to be used readily on rotary tables, milling machines, and surface grinders. Get details from Falcon Machine & Tool Co., 209 Concord Turnpike, Cambridge, Mass., or Circle Inform-A-Gram No. P48.

12-Ton OBI Presses

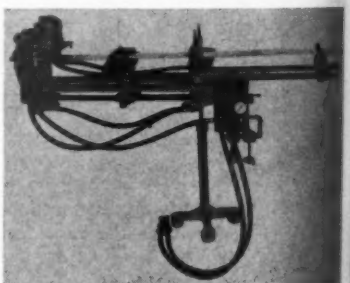
Use of balanced ribbing and controlled cooling of Sorbitic frame castings in these presses result in extra high strength and resistance to deflection for increased die life.



The series offers deep throat and slow speed presses. Electro Safe presses can be used in multiple units for economical stamping operations on long, narrow pieces. Get details from Kenco Mfg. Co., 5211 Telegraph Rd., Los Angeles 22, or Circle Inform-A-Gram No. P49.

Power Press Feed

The new Micro-Air 2 power press feed has a new brake drag and stock guide which acts only on the edges and doesn't mar polished



metal surfaces. Patented grippers adjust automatically and instantly to different stock thicknesses while running. Write Nadel Tool & Mfg. Co., Inc., 20 Warren St., New York 7, or Circle No. P50.

Is There Anything We Can Help You Straighten Out?

ANDERSON *Hydraulic Power* PRESS

CHECKS AND BENDS IN THE SAME POSITION

Manufacturers with straightening, checking, and truing operations that require more than ordinary speed and accuracy have found Anderson Power Presses to be the answer to their problems. Here are the results they report:

"Straightened 30 pieces per hour with former equipment. With Anderson Press, 120 per hour. Production increase 400%."

"Anderson Power Press with its complete attachments is definitely more flexible for all types of straightening operations. It is faster, more accurate, and pressure is easily controlled. It is simple to operate."

"Formerly had a tolerance on drawing of plus or minus .002". After installing Anderson Press changed drawings to plus or minus 1/2 thousandth."

These actual reports from users prove that with an Anderson Power Press you get it straight — fast. Profit from low-cost high production, precision straightening.

Write for Bulletin No. 5-46

Anderson

ANDERSON BROS. MFG. CO.
ROCKFORD, ILLINOIS

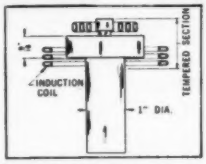
CIRCLE INFORM-A-GRAM KEY NO. 126

Lepel

HIGH FREQUENCY INDUCTION HEATING UNITS

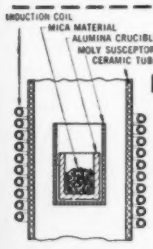
Lepel induction heating equipment represents the most advanced thought in the field of electronics . . . the most practical and efficient source of heat developed for numerous industrial applications. You are invited to send samples of work with specifications. Our engineers will process and return the completed job with full data and recommendations without cost or obligations.

TYPICAL INDUCTION HEATING APPLICATIONS



Punch Heads Selectively Tempered

Diagram shows arrangement for selectively tempering heads of alloy steel punches. The use of a combination type solenoid and pancake induction coil reduces hardness from Rc 55/56 to Rc 41/44, improving resistance to brittle fracture at the head of the punch. In this case a heating cycle of 55 seconds provides uniform tempering. A multiple position fixture, processing 4 pieces at one time, speeds up production.



Heating Non-Conducting Materials To High Temperatures

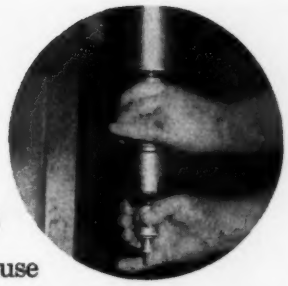
Laboratory analyses frequently require heating of non-conducting materials to temperatures of 3,000 to 3,500° F. in vacuum or special atmosphere. This can be accomplished by induction heating with the aid of a metal susceptor. Diagram shows the fusion of mica samples in an alumina crucible, using molybdenum susceptor. A ceramic tube surrounding the susceptor isolates the work for fusion in a vacuum. The molybdenum susceptor is heated by induction, which in turn, heats the crucible by radiation.

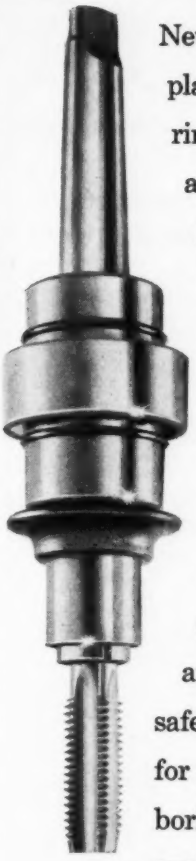
WRITE FOR NEW LEPEL CATALOG
Electronic Tube Generators from 1 Kw to 100 Kw.
Spark Gap Converters from 2 Kw to 30 Kw.

Lepel HIGH FREQUENCY LABORATORIES, INC.
55th ST. & 37th AVE., WOODSIDE 77, N. Y.

CIRCLE INFORM-A-GRAM KEY NO. 1271

New Chuck





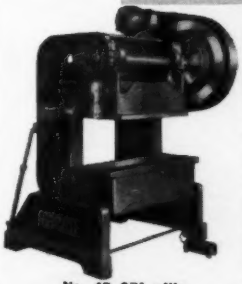
New chuck . . . with plastic Safety-Guard ring, prevents accidents and tool breakage because hands never grip collets or tools during quick changes while spindle is in motion. One hand lifts the locking ring—the other hand cups under the plastic Safety-Guard to control the collet. Hands stay away from sharp cutting edges, tools don't slip through hazard-conscious fingers. For replacement, operator lifts ring and inserts collet in one easy motion. Ring falls into place by gravity, and the cutting tool is ready. Here's increased safety and efficiency with multiple-spindle range for single-spindle machines on drilling, counterboring, reaming, tapping, and other sequence operations. Write for Bulletin No. 54-58.

Scully-Jones and Company SCULLY JONES
1913 So. Rockwell Street, Chicago 8, Illinois

CIRCLE INFORM-A-GRAM KEY NO. 1272

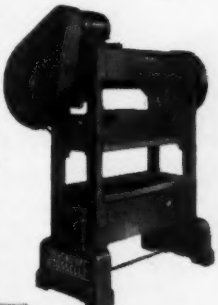
High-Output with ROUSSELLE

DOUBLE-CRANK PRESSES



No. 48 OBI with "Econo-Air" clutch.

SPEED UP PRODUCTION with these versatile 40-ton presses. Large bed and ram areas make them ideally suited to handle wide rolls or sheets . . . do multiple punching, steel-rule die work and other high output operations. For rapid, shockless starting and stopping, presses can be equipped with electrically controlled "Econo-Air" friction clutch . . . Ask for new catalog.



STRAIGHT SIDE —Die space up to 24 in.; bed space up to 6 ft. between uprights.

Choice of over 30 models and types in 5 to 60-ton sizes

SERVICE MACHINE COMPANY
Mfrs. of Rousselle Presses
2310 WEST 78TH STREET • CHICAGO 20, ILLINOIS

Rousselle Presses are sold exclusively through Leading Machinery Dealers.

CIRCLE INFORM-A-GRAM KEY NO. 1273

ALLEN
HEAVY DUTY
PUNCH PRESSES

Powerful
Dependable and Economical
Fully Guaranteed

Hundreds of different Model Combinations 1 to 12 ton Capacities

See your Supply Dealer or write for Catalog giving complete information, specifications and prices on our line of Heavy Duty Punch Presses.

Moderate in Price

Thousands in use the World over

ALVA ALLEN INDUSTRIES, Dept. TP
Clinton, Missouri Tel. TUrner 5-3331

CIRCLE INFORM-A-GRAM KEY NO. 1281

Every Shop Should Own One

No distortion — even on ⅛" stock! MODEL "C"

KNURLMASTER Hand Knurler

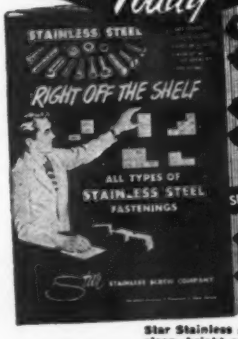
For small production runs on ⅛" to 1" stock. Exclusive screw design gives perfect knurl pattern. Furnished with 3 hardened straight or diamond pattern knurls of standard ½" dia. Forged steel frame is self-centering. Write for illustrated folder.

ROCKWIN MANUFACTURING CO.
80A MAGNOLIA AVE., WESTBURY, L.I., N.Y.

CIRCLE INFORM-A-GRAM KEY NO. 1282

WRITE, WIRE or PHONE FOR YOUR CATALOG *Today*

1960 issue now ready!



Star Stainless screws have clean—bright and shiny—heads

STAR STAINLESS SCREW CO.
679 Union Blvd., Paterson 2, N. J.
Telephone: CLifford 6-2300
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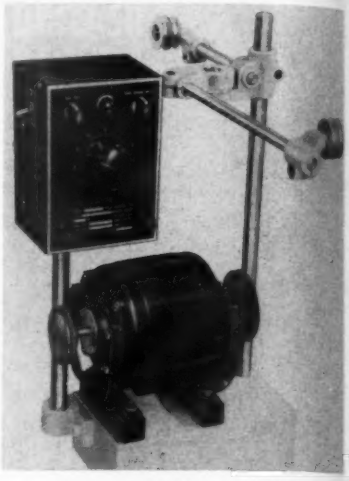
CORROSION RESISTANT

CIRCLE INFORM-A-GRAM KEY NO. 1283

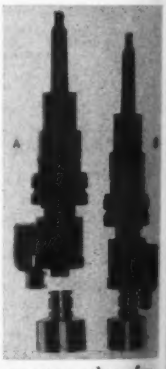
Product News

New Motor Drive Unit



A new variable speed motor drive for jewelers' type lathes provides continuously variable spindle speeds from 0 to 4000 rpm. It's a trouble-free unit containing no tubes and the dynamic braking is a feature useful in production work. Write Louis Levin & Son, Inc., 3610 S. Broadway, Los Angeles 7, or Circle Inform-A-Gram No. P51.

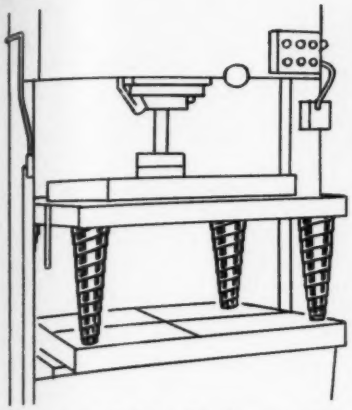
Neck Cutter Attachment



Machine awkward or irregular-shaped workpieces easily by keeping the work stationary while rotating the tool, or vice versa, using a new necking cutter attachment. Special snap-ring or O-ring grooves, chamfering, or other external machining can be handled quickly and accurately. Get details from Maxwell Industries, Inc., 493 E. 5th St., Ashtabula, Ohio, or Circle P52.

Guide Pin Cover

For protecting pins and bushings from nicks and scratches use the one-piece guide pin covers announced by the Elasticone Division



of Central Safety Equipment Co., 6601 Marsden St., Philadelphia 35. They snap into place to seal in lubrication and prolong die life. Get literature from the company, or Circle Inform-A-Gram No. P53.

Air Line Filters

Removal of liquids from compressed air lines is possible with Series 30BE Air-line filters. They feature 53% larger liquid capacity plastic bowls with a high safety factor and greater resistance to fatigue under cycling loads. Get details from the C. A. Norgen Co., 3400 S. Elati St., Englewood, Colo., or Circle No. P54.

BUY

U.S. SAVINGS BONDS

TODAY!

Why do ~~most~~ O.E.M.'s* specify TAPMATIC ?

Because *original equipment manufacturers want satisfied customers! Years of experience have proven that for consistently excellent quality threads, highest production on even automated set-ups, and negligible maintenance... TAPMATIC Tapping Attachments outperform all others.

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845 W. 16th Street Costa Mesa, California

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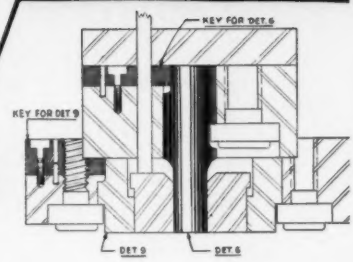
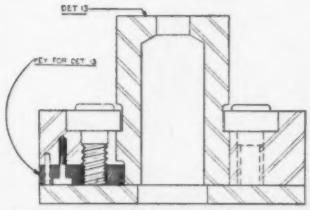
NEW
HOVIS KEY-ALIGNED DIE
THE LATEST ADDITION TO OUR STANDARD UNITS

a must for irregular stampings

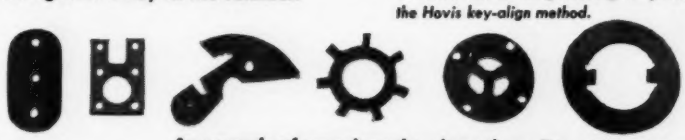




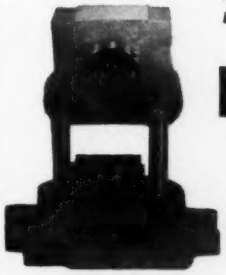
A section line drawing showing the principle of the Hovis key-align method.

ELIMINATES ALL SET-UP ERRORS AND INSURES UNINTERRUPTED ACCURACY

When producing irregular shaped stampings, it is important that the cutting members of the die are located in the proper radial alignment. Hovis has introduced the key-aligned die to meet this requirement... With the key-aligned die any press operator can install the inserts without the possibility of misalignment. This is accomplished with a flat on the insert which locates against a key in the retainer.



An example of some irregular pieces these dies produce by merely purchasing special sets of parts on which we are glad to quote



Made in 6 sizes:
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for producing WASHERS and SMALL STAMPINGS... No need to make a NEW DIE for every STAMPED PART

By simply removing and replacing five, small, interchangeable inserts a new part may be produced... This method makes possible all production including irregularly shaped pieces and shallow draws.

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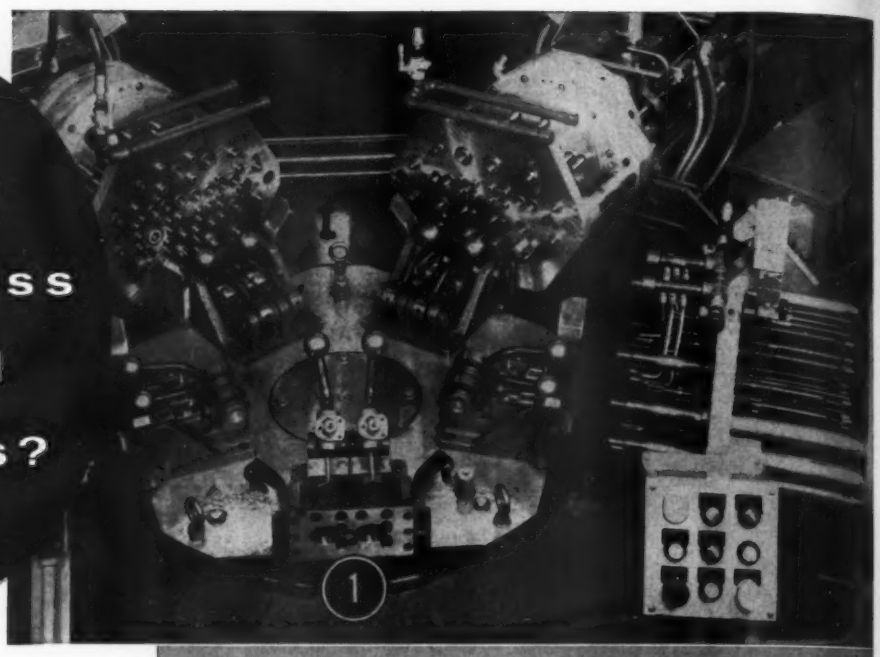
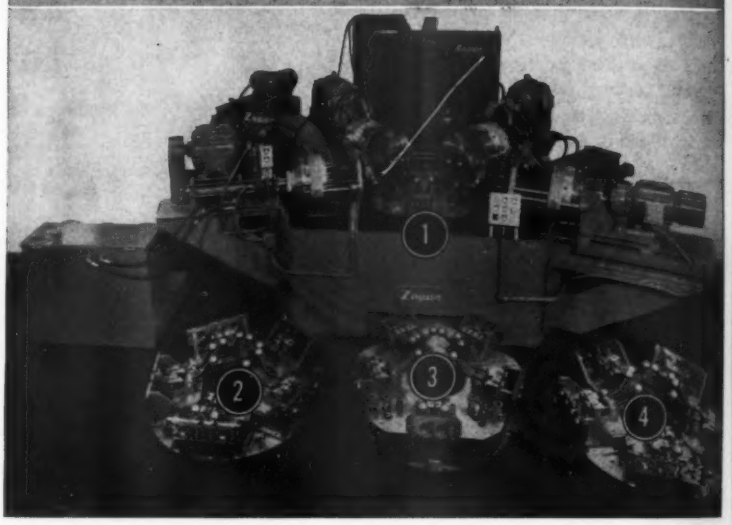
why gearless drill heads?



Four fixture assemblies, mountable on a common index table, have five stations each for drilling, reaming, and tapping left- and right-hand cylinders at 400 pieces per hour. In all, 2800 holes are produced.



because **Zagar** *design uses more spindles in smaller space with minimum tooling and requires short change-over time*

Zagar gearless design permits flexibilities in building machinery with results not obtainable elsewhere. By using many spindles and tooling more parts *in one machine*, fewer units, less space, and little change-over time are required.

Gearless design allows close center hole production without changing spindle locations in heads. Varying hole patterns can be obtained without additional heads. Interchangeable fixtures on the same index table, therefore, compound the potential hole production *—in one basic unit.*

Find out how Zagar can program your entire drilling, reaming, and tapping job by sending us a part for an engineering study.

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EDITORIAL ITEMS

C1	C14	C27	C40	P2	P15	P28	P41	P54
C2	C15	C28	C41	P3	P16	P29	P42	D1
C3	C16	C29	C42	P4	P17	P30	P43	
C4	C17	C30	C43	P5	P18	P31	P44	
C5	C18	C31	C44	P6	P19	P32	P45	
C6	C19	C32	C45	P7	P20	P33	P46	
C7	C20	C33	C46	P8	P21	P34	P47	
C8	C21	C34	C47	P9	P22	P35	P48	
C9	C22	C35	C48	P10	P23	P36	P49	
C10	C23	C36	C49	P11	P24	P37	P50	
C11	C24	C37	C50	P12	P25	P38	P51	
C12	C25	C38	C51	P13	P26	P39	P52	
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C1	C14	C27	C40	P2	P15	P28	P41	P54
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C3	C16	C29	C42	P4	P17	P30	P43	
C4	C17	C30	C43	P5	P18	P31	P44	
C5	C18	C31	C44	P6	P19	P32	P45	
C6	C19	C32	C45	P7	P20	P33	P46	
C7	C20	C33	C46	P8	P21	P34	P47	
C8	C21	C34	C47	P9	P22	P35	P48	
C9	C22	C35	C48	P10	P23	P36	P49	
C10	C23	C36	C49	P11	P24	P37	P50	
C11	C24	C37	C50	P12	P25	P38	P51	
C12	C25	C38	C51	P13	P26	P39	P52	
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WHY BUY METAL YOU DON'T USE?

Switch to Allegheny Ludlum Cast-to-Shape Tool Steel

FORGING

Stepped-out forging for fabricating spinning cone: 2300 lbs.—$2691 material cost plus cost of machining.

CAST-TO-SHAPE

Cast-to-shape spinning cone 1059 lbs. $860.97 Includes cost of the pattern.

$1,831 Saved by changing to Cast-to-Shape

Why pay for metal that ends up as chips on your floor? Here are two fine reasons for switching to Allegheny Ludlum cast-to-shape tool steels.

CAST-TO-SHAPE MEANS YOU BUY FEWER POUNDS OF METAL.

Because the tool you buy is closer to its finished shape, you obviously spend less money on original metal. In the above example, the savings in metal cost alone amount to $1,894.

CAST-TO-SHAPE MEANS LESS FINISH MACHINING.

A casting like that above has only ¼ to ⅜ inches of machine stock on all surfaces, requiring very little machining compared to solid chunks. Cast-to-shape tooling is especially economical when working with intricate shapes.

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Find out now how you can cut costs on your complex tools. Write for FC-4, a 28-page technical discussion of A-L's Forging and Casting Division with applications, pattern information, design tips, analyses, and heat treating instructions. Or call your nearest A-L tool steel warehouse or distributor.

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TOOLING & PRODUCTION Magazine

The number of subjects in which T&P's editors present material in just a few issues adds up very rapidly. Most articles are of lasting interest and have future reference value in solving tooling and production problems.

This cumulative index will build up progressively during each calendar year. Each issue will carry a cumulative index of material contained in all previous issues of the same year, with each January issue carrying the complete index of the twelve issues of the previous year.

We suggest you see to it that your copies of T&P are retained for future reference so you can get the full benefit of this useful index.

The Publisher

SUBJECT INDEX

Assembly
Q-C for, Feb., p. 66 (3 pp.)

Boring
Cartridge-type tooling, with, Feb., p. 53 (2.4 pp.)
Chip removal, after, Feb., p. 43 (.66 p.)

Carbides
Cartridge-type, for boring and facing, Feb., p. 53 (2.4 pp.)
Common sense use of, Feb., p. 49 (1 p.)
Machining hi-temp alloys with, Feb., p. 51 (1.9 pp.)
Machining tungsten with, Feb., p. 56 (3 pp.)
Throwaway tools, positive rake chip-breaker grooves in negative rake inserts, for doubled life, Apr., p. 62 (1.0 pp.)
Use of, Feb., p. 9 (1.16 pp.)

Cold Forming
Heading, fast, of tiny parts, Feb., p. 65 (.7 p.)
Swaging, choosing a machine, Feb., p. 59 (3 pp.)

Controls
Numerical, programming for drilling, Apr., p. 58 (4.0 pp.)
Tape, and common sense, Jan., p. 35 (1 p.)
Tape, for milling machine, Jan., p. 48 (2-1/2 pp.)
Tape, of Natco drill, to speed production, Mar., pp. 55 (2 pp.)

Computers
Operation of, for production jobs, Jan., p. 43 (5 pp.)

Cost Cutting
Production change, by, Feb., p. 46 (.4 p.)

Dies
Lamination, plus assembly, Jan., p. 37 (5 pp.)
Progressive, designs for two, Mar., p. 57 (3 pp.)
Progressive, for brass telephone parts, Apr. p. 65 (1.66 pp.)
Punch system for, Mar., p. 65 (.66 p.)

Drilling
Building-block machine for, Jan., p. 42 (1 p.)
Programming for numerically controlled, Apr., p. 58 (4.0 pp.)
Tape controlled, at Solar Aircraft, Mar., p. 55 (2 pp.)

Fixturing
Milling machine, for tape controlled, Jan., p. 48 (2-1/2 pp.)

Grinding
Lapping, a clue to, of irregular surfaces, Apr., p. 57 (1.0 p.)
Machine, new, double-spindle disc type, with, Apr., p. 64 (0.5 p.)
Wheels, lubricant for, Apr., p. 66 (.33 p.)
Thin parts, of, Mar., p. 64 (1.33 pp.)

Heat Treating
Tool steels, of, Mar., p. 51 (4 pp.)

Machining
Hi-temp alloys, of, Feb., p. 51 (1.9 pp.)
Tungsten, of, Feb., p. 56 (3 pp.)
Faster speeds, design linked for economy, Mar., p. 48 (3 pp.)

Maintenance
Machine, scheduling, for, Feb., p. 62 (1.3 pp.)

Management
Businessman's role in political action, Mar., p. 7 (2 pp.)
Depreciation, understanding of, Feb., p. 41 (2.3 pp.)
Executive appraisal, Apr., p. 55 (2.0 pp.)
European expansion, cash in on, Mar., p. 45 (2.66 pp.)
Foreign competition vs. standard of living, Jan., p. 33 (1 p.)
Inventions, who owns, Jan., p. 58 (1-3/4 pp.)
Maintenance, makes money, Apr., p. 9 (2.5 pp.)
Leasing, J & L Plan for, Feb., p. 63 (.66 p.)
Supervisory development, Mar., p. 61 (2.25 pp.)
Value Engineering, a tool, Feb., p. 39 (1 p.)

Marking
Electrolytic, on a production basis, Jan., p. 56 (2 pp.)

Milling
Tape controlled, tooling up, Jan., p. 48 (2-1/2 pp.)

Plating
Brush-on, versatile, Mar., p. 76 (1 p.)

Pneumatics
Circuits, fill-in approach to, Mar., p. 66 (5 pp.)

Pressworking
Die, carbide, for laminations, Feb., p. 50 (1 p.)
Laminations, of, and assembly, Jan., p. 37 (5 pp.)

Quality Control
Automatic inspection and sorting of tiny parts for, Feb., p. 47 (2 pp.)
Caliper, for measuring undercut walls, Feb., p. 70 (.66 p.)
Heavy assembly, for, Feb., p. 66 (3 pp.)
Managing, for profits, Jan., p. 9 **(2 pp.)**

Reaming
Close tolerance, Mar., p. 60 (1.33 pp.)

Spinning
'Big Stuff', hot- and cold, Jan., **p. 52 (2 pp.)**

Threading
Machines, indicator for alignment of, Apr., p. 67 (1.00 pp.)

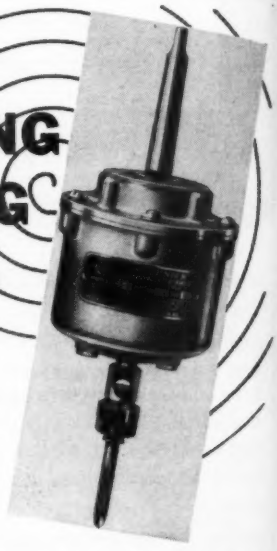
Tooling Cut Rate Hydraulic
Cut-rate, and methods, Apr., p. 51 (3.75 pp.)
Hydraulic combinations save time, Apr., p. 63 (1.5 pp.)

Transfer machine
Chip removal, in, Feb., p. 43 (.66 p.)

Turning
Automatic, with new turret lathe, Feb., p. 55 (.6 p.)
Indicator for, Feb., p. 64 (1.3 pp.)
Fully powered, with new VTL, Jan., p. 36 (1 p.)
Screw machine, with, to eliminate second operations, Feb., p. 44 (2.6 pp.)

Protect your future— BUY U. S. SAVINGS BONDS—TODAY!

STOP SPIRALING TAPPING COSTS



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SIZE	THREADS PER INCH
0000	160
000	120
00	90-96-112
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1	48-56-60-64-80-90
2	48-52-54-56-60-72-80-96
3	36-40-60-64-72-80
4	30-32-38-42-44-56-60-64-72-80-90
5	22-27-30-32-36-38-42-48-50-56-60-64-72-80
6	24-28-30-36-38-42-44-48-56-60-64-72-80
7	28-30-32-34-36-38-40-44-48-64
8	24-26-28-30-38-40-44-48-56-60-64-72-80
9	24-28-30-32-36-40
10	18-20-22-26-28-30-34-36-40-48-56-60-64-72-80-96
11	20-22-24-28-30-32-36
12	20-22-26-27-30-32-36-38-40-48-56-60-64-72-80
13	20-22-24-28-32
14	14-16-18-26-28-30-32-36-40-64
15	18-20-24-28-32
16	16-18-20-22-24-28-32-36
17	16-20
18	16-18-20-24-32-40
19	18-20
20	14-16-18-20-24-32
22	16-18-20-24
24	14-16-18-22-24
26	14-16-20-24
28	14-16-20
30	14-16-20
1/16	56-60-64-72
5/64	56-60-64-72
3/32	32-36-38-48-50-56-60-64
.100	100
.107	52
7/64	36-40-42-44-48-50-56
1/8	30-32-36-38-40-48-56-60-80
.132	50
9/64	30-32-38-40
.148	38
5/32	24-26-28-30-32-36-38-40-50
11/64	24-26-30-32-36-38-40
3/16	12-18-20-22-24-26-27-28-30-32-36-40-48-56-64-72
.198	24
13/64	24-28-30-32-36-40
7/32	20-22-24-26-27-28-30-32-36-38-40
.227	24
15/64	20-22-24-28-32-36-.246-40
1/4	10-12-14-16-18-22-23-24-25-26-27-30-32-36-38-40-48-50-56-60-64-72-80
17/64	12-18-20-24-27-28-32-40
.277	40
9/32	16-18-20-24-26-27-28-32-36-40-46-56
19/64	18-24
.300	28
5/16	10-12-14-16-20-22-26-27-28-30-32-36-40-44-48-50-56-64
21/64	16-18-20-24-36
11/32	16-18-20-22-24-26-27-28-32-36-40-64
23/64	16-24
.365	28
3/8	10-12-14-18-20-22-26-27-28-30-32-36-40-44-48-56-64
25/64	14-16-18-20-24-27-32-40-48
.402	24
13/32	12-14-16-18-20-24-27-28-32-40
27/64	14-20-24-28-32-36
7/16	10-12-16-18-22-24-26-27-28-30-32-36-40-48-56
29/64	12-14-16-20
15/32	12-14-20-24-27-28-32-36-40
1/2	10-11-12-14-16-18-22-24-26-27-28-30-32-36-40-44-48-56-80
33/64	12-13-20-24
17/32	10-12-13-14-16-18-20-24-27-28-32-40-64
.550	24
9/16	10-13-14-16-20-24-26-27-28-30-32-36-40-48-56-80
37/64	10-12-18-20-27
19/32	12-18-20-24-28-32-36-40
5/8	9-10-12-13-14-16-20-24-26-27-28-30-32-36-40-48-56-64
41/64	11-18-24
21/32	10-11-18-20-24-27-32-40-48
11/16	10-11-12-14-16-18-20-22-24-27-28-30-32-36-40
23/32	11-12-16-18-20-24-27-32-36-40
47/64	10-12-16-18-20
3/4	8-9-11-12-14-15-18-20-22-24-26-27-28-30-32-36-40-48
49/64	10-16-18-20
25/32	10-12-16-18-20-24-27-32-40
.800	16
13/16	8-10-12-14-16-18-20-24-27-28-32-40
.835	16
55/64	6-12
27/32	9-10-18-20-24-27-32-40-48
.850	14
7/8	8-10-11-12-13-16-18-20-24-26-27-28-30-32-36-40
29/32	9-12-14-18-20-24-27-28-32
15/16	8-9-10-12-14-16-18-20-24-26-27-28-32-40
31/32	8-9-12-16-18 20-24-28-32
1	5-7-9-10-11-12-16-18-20-24-26-27-28-30-32-36-40-48
1-1/32	8-12-14-16-18-20
1-3/64	12-14-16-18-20
1-1/16	7-8-10-12-14-16-17-18-20-24-27-28-32-40
1-3/32	7-8-9-12-14-16-18-20-32
1-1/8	8-10-14-16-18-20-24-27-28-32-40-48
1-5/32	7-8-9-12-14-16-18-20-24-32
1-11/64	18
1-3/16	7-8-10-12-14-16-18-20-24-27-28-32-40
1-1/4	8-10-14-16-18-20-24-27-28-32-40
1-5/16	6-7-8-10-12-14-16-18-20-24-27-28-32-40-48
1-3/8	5-8-10-14-16-18-20-24-27-32-40
1-13/32	12-16-18-20
1-7/16	6-8-10-12-14-16-18-20-24-27-28-32-40
1-1/2	7-8-9-10-13-14-16-18-20-24-27-28-32-40
1-17/32	7-12-16-18-20
1-9/16	6-8-10-12-14-16-18-20-24-32-40
1-5/8	5-5½-6-8-10-11½-12-13-14-16-18-20-24-28-32-40
1-11/16	8-10-12-14-16-18-20-24-32
1-23/32	5-8-12-16-18-20
1-3/4	5-6-8-10-12-13-14-16-18-20-24-28-32-40
1.767	18
1.7715	12
1-13/16	8-10-12-14-16-18-20-24-32
1-7/8	5-8-10-12-14-16-18-20-24-32
1-29/32	12-16-18-20-32
1-15/16	8-10-12-14-16-18-20-24-32
2	4½-6-8-10-12-14-16-18-20-24-28-32
2-1/16	8-10-12-14-16-18-20-24-32
2-1/8	4½-8-10-12-14-16-18-20
2-3/16	8-10-12-14-16-18-20-24
2-1/4	4½-8-10-12-14-16-18-20-24
2-5/16	8-10-12-14-16-18-20-24
2-3/8	4-8-10-12-14-16-18-20-32
2-7/16	8-10-12-14-16-18-20
2-1/2	4-6-8-10-12-14-16-18-20
2-9/16	8-10-12-14-16-18-20
2-5/8	4-8-10-12-14-16-20-32
2-11/16	8-10-12-14-16-18-20-32
2-3/4	4-8-10-12-14-16-18-20-32
2-7/8	4-8-10-12-14-16-18-20-24-32
2-15/16	8-10-12-14-16-18-20-32
3	3½-4-8-10-12-14-16-18-20
3-1/16	20
3-1/8	4-8-10-12-14-16-20
3-3/16	4-8-10-12-14-16-20
3-1/4	4-8-10-11-12-14-16-18-20
3-3/8	4-8-10-12-16
3-1/2	4-8-10-12-16
3-5/8	4-8-10-12-16
3-3/4	4-8-10-12-16
3-7/8	4-8-10-12-16
4	4-6-8-10-12-16
4-1/8	4-8-10-12-16
4-1/4	4-8-10-12-16

Many more sizes in stock up to 6" dia.

LEFT HAND N.C. (USS)—N.F. (SAE) SIZES

SEE ABOVE SECTION FOR MORE SIZES

SIZE	THREADS	SIZE	THREADS	SIZE	THREADS	SIZE	THREADS
0	80	8	32-36	7/16	14-20	1"	8-12-14
1	64-72	10	24-32	1/2	13-20	1-1/8	7-12
2	56-64	12	24-28	9/16	12-18	1-1/4	7-12
3	48-56	14	20-24	5/8	11-18	1-5/16	6-12
4	36-40-48	1/4	20-28	11/16	11-16	1-3/8	6-12
5	40-44	5/16	18-24	3/4	10-16	1-7/16	6-12
6	32-40	3/8	16-24	7/8	9-14	1-1/2	6-12

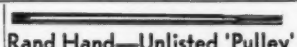
'OVERSIZE' and 'UNDERSIZE' TAPS

RIGHT AND LEFT HAND N.C. AND N.F. SIZES

MACHINE SCREW	#2 to #5	Plus or Minus	.002, .003, .005
MACHINE SCREW	#6 to #14	Plus or Minus	.003, .005, .010
FRACTIONAL	1/4" to 1-1/2"	Plus or Minus	.003, .005, .010 .015, 1/64, 1/32

Right & Left Hand—Unlisted 'Gun' or Spiral Pointed Taps

Size	Threads	Size	Threads
0	80 NF		
1	56 NS	7/8	9 NC, 14 NF
2	56 NC, 64 NF	1	8 NC, 12-14 NF
9/16	12 NC, 18 NF	1-1/8	7 NC, 12 NF
5/8	11 NC, 18 NF	1-1/4	7 NC, 12 NF
11/16	11 NS, 16 NS	1-3/8	6 NC, 12 NF
3/4	10 NC, 16 NF	1-1/2	6 NC, 12 NF



Rand Hand—Unlisted 'Pulley' And Extra Length Taps

Size	Threads	Size	Threads
4	36-40 NC, 48 NF	3/8	24-NF
5	40 NC, 44 NF	7/16	20 NF
6	32 NC, 40 NF	1/2	20 NF
8	32 NC, 36 NF	9/16	12 NC
10	24 NC, 32 NF	9/16	18 NF
12	24 NC, 28 NF	5/8	18 NF
1/4	28 NF	3/4	16 NF
5/16	24-NF	Also Larger Sizes	NC & NF

UNLISTED Right Hand "Pipe" Taps

"NPT" Taper	"NPT" Thread	"NPS" Size	"NPS" Thread	EX. LENGTH "NPT" & "NPS" Size	EX. LENGTH "NPT" & "NPS" Thread
1/16	27	1/16	27		
1/4	27	1	8		
2-1/2	8	1-1/4	11½	1/16	27
3	8	1-1/2	11½	1/8	27
3-1/2	8	2	11½	1/4	18
4	8	2-1/2	8	3/8	18
Also British		3	8	1/2	14
		3-1/2	8	3/4	14
		4	8	1	11½
		Also British		Also British	

Lefthand 'Pipe Taps' Taper and Straight

Size	Thread	Size	Thread
1/16	27	1	11½
1/8	27	1-1/4	11½
1/4	18	1-1/2	11½
3/8	18	2	11½
1/2	14	2-1/2	8
3/4	14	3	8
Also British		3-1/2	8
		Also British	

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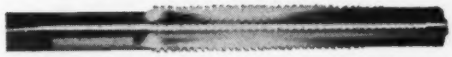

IF NOT IN STOCK—7 to 10 DAYS DELIVERY—When ordering or requesting quotations, kindly furnish following information:

(a) Kind of material being machined.
(b) Depth of hole in inches, through or bottom.
(c) Tap to be used horizontally or vertically.
(d) Will tap turn, or is piece expected to be turned.
(e) Is tapping job expected to be done in one pass.
(f) Would tap be backed out of hole, or machined stopped for release of tap.
(g) If possible, submit thread length, and overall length of tap desired with blue print.

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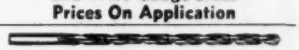

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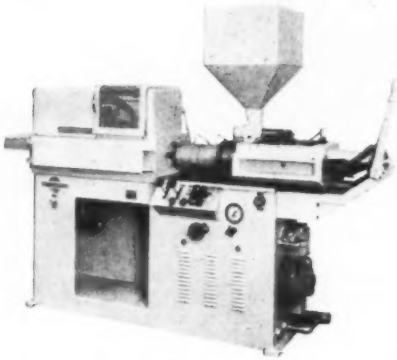

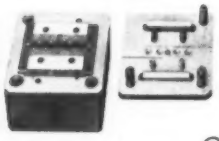

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ADVERTISER'S INDEX

Ace Drill Corporation 78
Acme Industrial Company 113
Acme Tool Corporation 100
Aget Manufacturing Co. 124
Alina Corporation 119, 121
Allegheny Ludlum Steel Corp. 131
Alva Allen Industries 128
Allenair Corp. 120
American Drill Bushing Co. 140
American Optical Company 35
Anderson Bros. Mfg. Co. 126
Armstrong Brothers Tool Co. 123
Atlas Press Company, Clausing Division 7, 80

Balas Collet Mfg. Co. 139
Bald Eagle Corporation 102
Bausch & Lomb Optical Co. 14, 19
Bellows Company 68
Besly-Welles Corp. 30
Branch Manufacturing Co. 109
Burgmaster Corporation 92
H. L. Bushman Co., Inc. 129

Central Safety Equipment Co. 124
Chicago Tool & Engrg. Co. 112
Cincinnati Milling Machine Co. 67
Clausing Division Atlas Press Company 7, 80
Comet Tool Company 117
Comtor Company 120
Contract Services Directory 100
Cook's Lead Hammer Service 132
Cooper Weymouth, Inc. 114
Corrosion Reaction Consultants 117
Cosa Corporation 99
Cratex Mfg. Co. 120

Dake Corporation 136
Danly Machine Specialties, Inc. 6
Dayton Rogers Mfg. Co. 123
Dearborn Gage Co. 90, 110, 132
Delta Power Tool Div., Rockwell Mfg. Co. 25
F. W. Derbyshire, Inc. 112
Detroit Reamer & Tool, Inc. 27
Detroit Testing Machine Co. . . 119, 137
DeVlieg Microbore Div. DeVlieg Machine Co. 29
Dilley Mfg. Co. 109
Durant Tool Supply Co. 78
Dykem Company 137

Economy Engineering Co. 135
Edlund Machinery Corp. 91
Eisler Engineering Co. 110
Enco Manufacturing Co. 102
Engelhard Hanovia, Inc. 138
Erickson Tool Company 40
Ex-Cello-O Corp. 73

Federal Press Co. 69
Federal Products Corp. 81
Field Tool Supply Co. 119, 133
M. A. Ford Mfg. Co. 105

Gatco Rotary Bushing Co. 105
General Tool Division General Fire Extinguisher Corp. . . 36
Genesee Manufacturing Co. 109
Gisholt Machine Co. 89
George Gorton Machine Co. 42
Graphic Systems 116

Hamilton Tool Company 13
Hannifin Company Div., Parker-Hannifin Corp. 100
Hardinge Brothers, Inc. 32
Harig Manufacturing Corp. 33
Heimann Mfg. Co. 114
Heinrich Tools, Inc. 114
Hill Acme Co. 16

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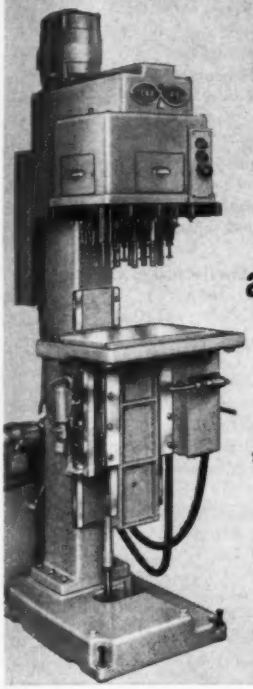

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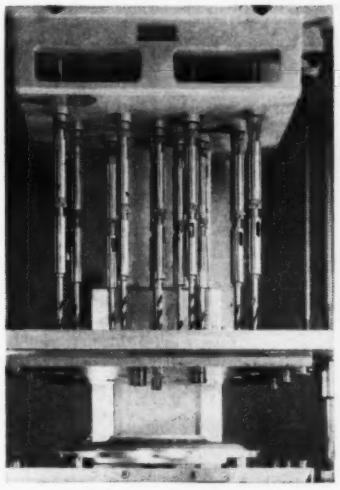

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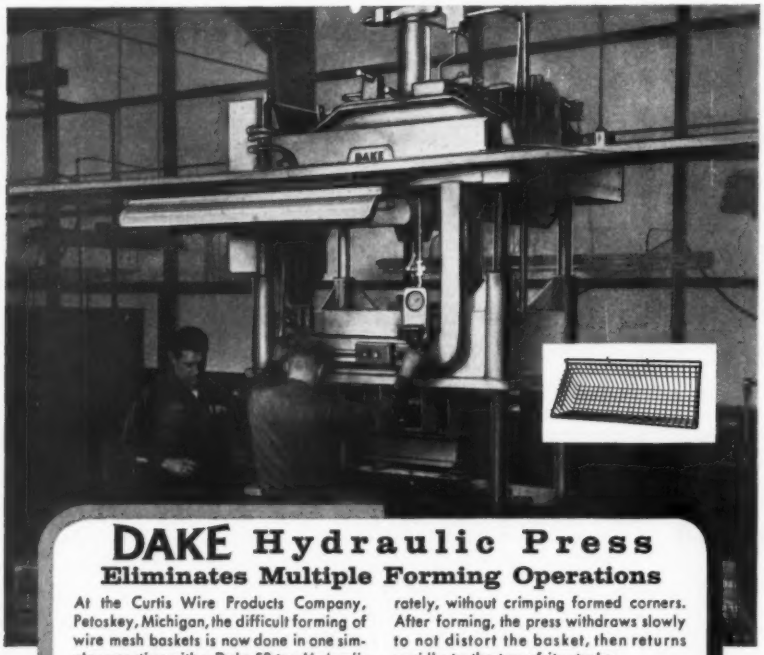

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ADVERTISER'S INDEX

Hovis Screwlock Co. 129
Huebner Publications, Inc. 37-135
Wm. T. Hutchinson Co. 134
Hydraulic Press Mfg. Co. 23

Ideal Industries, Inc. 138
Industrial Tectonics, Inc. 109
Ingersoll Milling Machine Co. 86

Jacobs Mfg. Co. 10
Jergens Tool Specialty Co. 117
C. E. Johansson Co. 78
I. O. Johansson Co. 107
S. C. Johnson & Son, Inc. 87

Kaufman Manufacturing Co. 111
Kennametal, Inc. 72
Kidde Precision Tool Corp. 110

Lassy Tool Co. 124
Latrobe Steel Co. 8
Lempco Industrial, Inc. 84, 102
Lepel High Frequency Labs. 127
Linderme Engrg. & Service 114
F. J. Littell Machine Co. 111

M & S Equipment Co., Inc. 105
MBI Export & Import, Ltd. 38
Mahr Gage Co. 123
Marshall Steel Company 123
Jas. H. Matthews & Co. 102
Meier Brass & Aluminum Co. 107
W. F. Meyers Co., Inc. 107
Michigan Special Machine Co. 12
Micrometrical Mfg. Co. 22
Milwaukee Cylinder Co. 119
Mohawk Tools, Inc. 73
Moore Special Tool Co. 39

National Broach & Machine Co. 15
Newton Hydraulic Tooling Co. 21
Niagara Machine & Tool Works 79
Northwestern Tools, Inc. 112

Ohio Knife Co. 97
O'Neil-Irwin Mfg. Co. 9

Pipe Machinery Co. 18
Pope Machinery Corp. 101
Porter Precision Products 95
Prebco Bushing Co. 129
Precision Tool & Mfg. Co. 135
Procunier Safety Chuck Co. 132
Producto Machine Co. 71
Punch Products Corp. 82

R-O Manufacturing Co. 122
Radio Corporation of America Industrial & Automation Div. 88
Reid Tool Supply Co. 88
J. A. Richards Co. 130
Rockwell Mfg. Co., Delta Power Tool Div. 25
Rockwin Mfg. Co. 128
Rodgers Hydraulic, Inc. 88
Rotor Tool Company 3
Rust-Lick, Inc. 114
Ruthman Machinery Co. 137

S & E Machine Products, Inc. 103
Sales Service Mfg. Co. 124
Scherr-Tumico Company 124
Geo. T. Schmidt, Inc. 118
Scully-Jones & Co. 127
The Sentry Company 82
Service Machine Co. 127
Shell Chemical Co. 17
Shore Instrument & Mfg. Co. 110
Sintercast Div., Chromalloy Corp. 115

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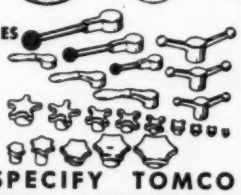

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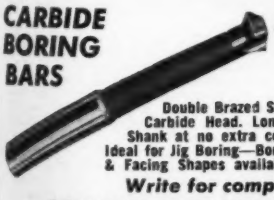

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ADVERTISER'S INDEX

Standard Tool Co. 134
Star Stainless Screw Co. 120
Steel City Testing Machines, Inc. 77
Superior Steel Products Corp. 98
Supreme Products Corp. 83
Sutton Tool Company 2

Tapmatic Corp. 129
Thor Power Tool Co. 26
Tool Components, Inc. 114
Thriftmaster Products Corp. 31
Titan Tool Supply Co. 137
Tomco, Inc. 137
Tomkins-Johnson Co. 74
Twentieth Century Mfg. Co. 107

United States Diamond Wheel Co. 4
Universal Engineering Co. 20

Valvair Corporation 94
Vascoloy-Ramet Corp. 5
Vernon Devices Inc. 36
Vidmar, Inc. 28
Vulcan Tool Company 77

Wales-Strippit, Inc. 85
Walls Sales Corp. 116
Waterbury Farrel Foundry & Machine Co. 96
Watts Brothers Tool Co. 110
Weldon Tool Company 24
Wells Manufacturing Co. 82
Wespo Div. of Vlier Engrg. 76
S. B. Whistler & Sons, Inc. 111
K. R. Wilson, Inc. 93
Wilton Tool Mfg. Co., Inc. 134
Wollensak Optical Co. 125

The Yoder Company 34

Zagar, Inc. 130

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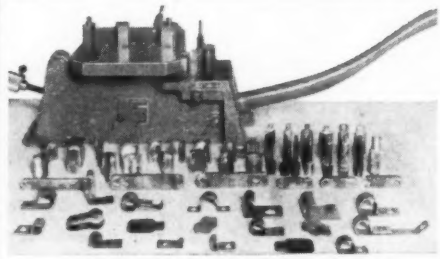

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